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A Retrospect.

WINGED Time has brought us within a few days of the close of another year, when, in the business affairs of life, it is customary for us, individually and collectively, to take account of their position, as the result of the year's work. Just as the life and the material progress of the individual are the sum of, comparatively speaking, a number of little things, so is the life and progress of an industry, however great its magnitude, and however influential. "The posi-"tion," says the Chairman of a Gas Company at the half-yearly meeting, or the Chairman of a Gas Committee when annually reporting at the meeting of the Council, "is emi-"nently satisfactory;" but the Chairman in his gratification does not, as a rule, halt to consider, unless it be in the most cursory manner, the many things that have, by their affinity or natural suitability, entered into association—despite the counteraction of inimical conditions—to bring about that position, nor the bearing those same things may have upon the future. Sufficient for him that things are as they are. To others than the expert, it is only those matters that are commercially salient that trouble, and then only so far as the present and the immediate future are concerned. Hence the value of the periodical retrospect, and the application of its teachings to guide in the future and to assist, as far as possible, to a correct judgment of prospects. We take a general survey of the year's history of the gas industry as written in the volumes of the "JOURNAL;" and that general survey does not denote anything of particular significance that distinguishes the year from others. But if we subject the events of the year to a closer examination, we find that, though certain repressive market conditions mingled with the progressive aids, the year closes with the industry richer technically and stronger in popularity and service than at the opening. So much so are economy of production and use and popularity advancing, notwithstanding competition in all the ways of advance, that we look confidently to the official returns for the year—true, their issue will be yet some time hence—to show that the progress in the staple business of the industry compares as favourably with 1905 as 1904 did with 1903. The Board of Trade returns issued during the past year were for 1904; and the sale of gas by authorized undertakings in that year supplemented that of 1903 by the substantial amount of 3,902,031,533 cubic feet.

The industry, being for the most part under statutory control, and largely dependent upon the prosperity of the other industries of the country, is not immune from outside influences. At the opening of the year, the country politically was in a sadly uncertain position. The Conservative Ministry had abdicated; the Liberal Party was in power pending the General Election which took place during January. The result of that election—a result produced through causes it is not our business to enter into here—was an unmistakable one; and it put Sir Henry Campbell-Bannerman into authority with a coalition party of a strength that has had no equal in the modern history of our Legislature. The new Parliament, too, was found to be unique in its democratic character. A still more striking feature was the imposing place that Labour, by its own potency, had taken in the national assembly; and, what is more, Labour was distinguished by the continuance of Mr. John Burns in the position of President of the Local Government Board—a position which he has to the present filled with that characteristic fidelity to any cause in which he has had part, whether or not the cause has had general approbation. If the times were significant of change when we were making our retrospect of 1905, they were still more so the few weeks after, when the composition of the new Parliament was seen. The Labour Party, or a large section of it, soon made it known far and wide that class legislation and communism were the main features of their programme. We admit the complete right of representation to all classes of the community; but it is a pity that Labour's representation should be so largely composed of Socialists and extremists. Notwithstanding this, the Government have shown a remarkable obedience to the dictates of these representatives, amounting to an undignified servility, with recantation of some deliberately formed Ministerial views and measures. The result has been that the Labour Party have practically had their own way all along the line, in connection with the Compensation and Trades Disputes Acts. In the former, all classes of employment are included save that of policemen, out-workers, and men of the Army and Navy; and in the latter, Trade Unionism is now privileged to a dangerous degree. The provisions of these Acts will at an early date receive notice in the "JOURNAL."

The Compensation and Trades Disputes Bills occupied a large part of the session, particularly of the rear portion that was brought to an end last Friday. But from the beginning of the session, it was abundantly clear that—opportunity being a fine thing—the doctrine of municipalization should not only be preached, but should be put into practice, to as great a length as time would allow. On the Select Committees to which Private Bills were referred, Labour had representation, and introduced to the work were also many other new members of Parliament—among them several who had stepped direct from the chambers of civic administration into the chamber of national and Imperial legislation. Their attitude and judicial spirit had not escaped the curbs of parochialism; and, while they essayed at justice to private enterprise when this was unassailed by municipal interests, when the question of Municipalization *versus* Private Enterprise arose, then certain it was that the former would come out on the top. The Gas Bills will be treated upon further in the paragraphs dealing with parliamentary matters; but let us instance here—as coming within the limits of the view of the gas industry, and as corroborating what has been said—the London County Council electricity scheme, involving its millions, the compulsory purchase of the Pontefract Gas Company's works, and the suspensory clauses in the Merthyr and East Hull Gas Companies' Acts. Whatever may be the view of the work of the new Parliament in the first session, taken as a whole, certain it is that labour and municipal ambition have had their full fling; but there are already signs that, so far as municipalization is concerned, those sitting at Westminster are representing not the views of communities but their own individual opinions. Discontent with local expenditure showed itself to be a vigorous growth at the recent municipal elections; and there is to be a strong effort to turn the direction of the policy of the London County Council at the elections next March.

While referring to labour from the legislative aspect, passing allusion may be made to the labour of the industry. Changing circumstances have produced some changes in the amount of labour required in relation to a given quantity of output; but prosperity and expansion have simply transferred a proportion of labour from one department to another, and opened up callings where much greater intelligence is required and more responsibility is involved. Excepting in just one or two isolated instances, peace has reigned throughout the industry in connection with labour during the whole year. The disputes that have occurred have been comparatively small in character and number; and their mention gives greater point to the present peaceful rule. At Huddersfield there was an official request for higher wages, to which, after a full inquiry by them, the Gas Committee could not accede. But the incident showed that good wages are being paid for labour in the gas industry, and that Huddersfield is not behind in this respect. There was also a temporary dispute at Blackburn in connection with the use

of stoking machinery; but the little cloud soon vanished. The year brought many evidences of the considerate treatment that the workers of the industry receive from their employers; but of all the projects for solidifying interest between employees and employers, Sir George Livesey still holds that the scheme which, in the gas industry, had its origin at the South Metropolitan Gas Company's works, and is now applied in the case of five Gas Companies and one Corporation, is the best. We cannot avoid mentioning this, in view of the remarkable sum which was, in the last co-partnership year, distributed among the South Metropolitan officials and men, and which the Company find themselves in a position to distribute, with gas at 2s. per 1000 cubic feet. The amount was £44,000; and it represented 9¾ per cent. on salaries and wages. The result of seventeen years of co-partnership in this one Company is the holding by the "co-partners" of £250,559 of stock, with £55,650 on deposit at interest, and £24,500 invested in houses—a grand total of £334,709. Nothing has ever been done in the gas industry for any section of its labour that can at all compare with this. In the United States, a notable commencement of the system of profit-sharing has been made by the adoption of a scheme by the Boston Gas Company—a gas undertaking of the first importance. It may fittingly be recorded here that this Company are also the first on that side to adopt a sliding-scale for the regulation of dividend. Following the example of Belgium, it became law in France this year that workers in all occupations should have Sunday rest, or in certain callings, where the public service demands Sunday labour, one other day in seven or fourteen as specified. A Bill has now been introduced in this country to compel the provision of rest-days—preferably Sunday—in all forms of service other than domestic. The year saw certain localized differences in the coalfields; and there were prognostications at one time that, both through the coal miners and railway men, the normal condition of affairs might be very seriously broken into. But the prophets have fortunately proved to be false.

From these particular features of labour, it is an easy passage to the more general question of the unemployed; and it is pleasing to note that this question does not continue to be a pressing one. That it is not so, however, is partly due to the means which have been organized (with the assistance of a rate-in-aid) to deal with it; but chiefly because, with a partial recovery of the building trades, its acuteness has worn off. Much of the problem still remains unsolved, and is engaging the attention of Mr. John Burns, who has shown an independence in dealing with it, and a knowledge of the real necessities of the case, that are likely to prove invaluable. It is at least as necessary to determine what is to be done with those who will not work as with that deserving class of unemployed who are unable to find work for which they are qualified. The latter are not only entitled to the fullest sympathy, but also to be assisted in every legitimate way.

Turning from labour to matters affecting finance, it is satisfactory to note that the trade of the world has steadily increased in volume; and it has perhaps at no time been better than it is at the present moment. From almost all quarters have come the same unvarying tale of increasing prosperity; while our own imports and exports have now reached figures which are wholly without precedent. Trades which a few years ago were said to be "going," have not only not yet gone, but flourish more than ever; while—astonishing to relate—America and Germany have become customers of this country for iron. So much is this the case, that there is now a scarcity of steel-making iron; and our metallurgical experts are hard at work endeavouring to devise means for overcoming the difficulty. If the outcome should be a more general recourse in this country to basic steel, the effect will be permanently beneficial, since it will render manufacturers less dependent upon hæmatite ore, the supply of which is limited. If, too, the calamities of war have not been felt during the past year, there have been visitations of earthquake, attended by fire, scarcely less calamitous in their results. The partial destruction of San Francisco, followed a few months later by the still more appalling disaster at Valparaiso, enlisted universal sympathy with the sufferers from these unlooked-for catastrophies, coupled with admiration at the fortitude with which such dire misfortunes were borne, and the resolution to restore the ruined cities with the least possible delay.

This display of energy was by no means without its effect upon the markets for labour and material; while from the drain of gold which it occasioned, the Money Market, already strained by the general revival of trade, has not yet quite recovered. It may almost be regarded as having given the impulse to the upward movement which culminated in October in the unprecedentedly high Bank rate of 6 per cent. Strange to say, this dearness of money has had little or no depreciating effect on the value of securities, many of which are marked higher to-day than they were previous to the Bank rate being advanced to its present figure. In fact, it appears, so far, to have only acted as a stimulus to investment; and gas securities, among others, have increased in favour. There is solid reason for this in the fact that the dividend-earning powers of gas undertakings have been practically unaffected by the competition of the electric light undertakings, the dividends of which in some cases have suffered reduction. A comparison recently made by "The Times" between gas and electricity undertakings establishes the fact that, while there has been a general fall in electrical securities, a substantial rise has taken place in gas stocks. The high estimation in which gas is held by the investing public is shown by the ease with which additional capital has been raised as required, whether offered by auction or by tender. The large amounts of capital that have been offered by auction (principally by Mr. Alfred Richards) from time to time during the twelve months have realized excellent prices, considering the fact that the Money Market has been against sellers—in some cases, we have observed, the prices have for the particular companies been record ones. The ease with which gas stocks have been disposed of in this manner is an indication of gratifying significance.

This popularity of gas stocks is, however, at times apt to be the undoing of the unwary investor. It has been our duty upon more than one occasion to warn him against schemes that have appeared to be devised for no other purpose than to put money into the pockets of the promoters. The latest and most flagrant case of the kind was that of the Kent County Gaslight and Coke Company, which was justly denounced by Mr. Justice Joyce as being "nothing "better than a swindle." Here was a small gas undertaking, which was quite recently transferred for £2350, sold to a confiding public for £21,800, or about ten times its value. The prospectus issued to the public inviting subscriptions was—again to quote Mr. Justice Joyce—a "most "cunningly devised document." It carefully concealed the fact that the works to be taken over had a consumption of only about 3 million cubic feet of gas per annum, and were so small that ¼ acre of ground sufficed for their accommodation. It gave, moreover, a misleading description of the district to be supplied and of the demand that awaited the power of the Company to supply, inasmuch as the former was almost purely agricultural, and the latter existed mainly in the imagination of the promoters. Intending investors cannot too carefully scrutinize prospectuses of all new ventures that may be brought under their notice, whether these relate to gas or any other trading concern; and they would do well, if without special knowledge themselves, to consult someone who has, before committing themselves by an application for shares.

The continued and increasing dearness of money has had the effect of keeping down the expenditure of local authorities; while also the fear of the electric light as an opponent has, to some extent, checked their aspirations to become owners of gas undertakings, notwithstanding the favour with which municipalization is regarded by the new Parliament. Last session, as stated in an earlier paragraph, suspensory clauses were inflicted in two instances—the Merthyr Tydfil and East Hull Gas Companies—providing for the non-exercise of certain powers granted by these respective Acts, in the event of application to purchase the undertakings being given during the ensuing year. The clause has lapsed as regards Merthyr Tydfil, owing to the decision of the Council of that borough not to promote a Purchase Bill; but the clause continues to be operative as regards the Hull undertaking, since the Local Authority are promoting a Bill for purchase. In the case of Pontefract, the Corporation obtained authority to purchase the undertaking of the Gas Company in despite of their strong opposition; but beyond the necessary notice to proceed under the powers of the Act being given, nothing further has been done. It may also be noted that the purchase

schemes at Aberystwith, Hitchin, and Weston-super-Mare were dropped.

In other respects, the gas legislation of the year has been by no means featureless. By the Cheltenham Gas Act, the Company obtained a triple measure of relief in the shape of a reduction of illuminating power, the abolition of sulphur restrictions, and change of burner—a probably unique experience; accompanied, however, by some rather unusual conditions as to testing for pressure, as though the Company could not be relied on for giving whatever amount of pressure may be required to promote consumption! At last, the South Suburban Company succeeded in obtaining a reduction of illuminating power to 14 candles, tested by the "Metropolitan" No. 2 burner, and with the proviso that the Company are not to be liable to any penalty in respect of any deficiency of illuminating power not exceeding half a candle. In place of the neutral zone of 4d.—viz., from 2s. 10d. to 3s. 2d. per 1000 cubic feet—2s. 9d. has been fixed as the standard price, with a variation of 1s. 8d. per cent. in the dividend for every 1d. change of price. A departure from the Gas-Works Clauses Act, 1847, is remarked in the Southampton Gas Company's Act, in respect of the notice required to be given by the Company previous to breaking-up streets or roads; this being extended from three to seven days. The Tottenham and Edmonton Gas Act empowers the Company to supply "power" gas, subject to any regulations the Home Secretary may make with regard to its distribution, and to any general legislation that may hereafter be framed on the subject. Similar conditions are imposed on the Truro Gas Company, who are also authorized to supply "power" gas having a minimum heating value of 250 B.Th.U. per cubic foot. For such gas, a charge not exceeding 1s. 6d. per 1000 cubic feet may be made, with an extra 1d. for every additional 25 B.Th.U. It is not very easy to see what advantage such gas can be to anyone at such a price. The illuminating power of the ordinary gas supplied by the Company is reduced to 13 candles; as is the case also with the Uxbridge and Watford Gas Companies.

The Cardiff Gas Company obtained powers to raise further capital and extend their district by the purchase of a small neighbouring gas undertaking; the maximum price applicable to Cardiff being fixed at the very low rate of 3s. per 1000 cubic feet, with a differential price of 3d. for the outside districts. The Company are expressly precluded from selling, letting for hire, or otherwise dealing in dynamos, motors, or other electrical appliances, apparatus, or fittings, within the City of Cardiff, or within the parish of Eglwysilam, if within three years from the passing of the Act electricity is being supplied by the Local Authority in that part of the parish included in the Company's area of supply. The Derby Gas Company obtained an extension of their area of supply, and authority to purchase two neighbouring gas undertakings, together with the abolition of sulphur restrictions, and substitution for the "Wandsworth" burner prescribed by their Act obtained two years ago of the "Metropolitan" No. 2 burner. It is satisfactory to notice that the latter burner has been adopted in the majority of cases, and may now be regarded as the parliamentary test-burner, since its use is enjoined by a model testing clause which has received the official sanction of the parliamentary authorities. The same clause prescribes the use of the bar photometer, and the Harcourt 10-candle pentane lamp. The common sense of Parliament has thus stepped in to prevent the perpetuation of the table photometer, although this may linger for a time in the Metropolis and other places unaffected by current scientific opinion. The publication of the Gas Referees' revised notification at the beginning of the year was an event of importance.

It is also satisfactory to notice that there was during the past session less stringency with regard to discounts. It has always been difficult to follow the reasons for prescribing 10 per cent. discount for prompt payment, and 15 per cent. additional for large or special consumptions. No one dreams of giving so large a discount as 10 per cent. for prompt payment, and there is never any necessity for so doing; while an additional discount of 15 per cent. is of little use to many undertakings in their competition with suction producers. It is now held to be sufficient if the provisions in the Gas-Works Clauses Act, 1847 (clause 13), be so amended as to provide for equality of treatment under like conditions of consumption. This secures to gas undertakings the full measure of liberty in regard to the conduct of business that has been consistently advocated in these columns.

Perhaps the most notable feature of the session was the passing of the Bill jointly promoted by fourteen Gas Companies to secure relief from sulphur restrictions. Only one local authority—the Newcastle Corporation—was found in opposition to the Bill when it came before the Commons Committee. But the case against abolition was fought by that Corporation for all it was worth; the result, however, being a complete triumph for the Companies. Similar relief was secured by separate action by other Companies, including the Wandsworth and Putney Gas Company. Mention must be made of the abortive attempt of the Mid-Oxfordshire Gas Company to persuade the Unopposed Bills Committee of the House of Commons that it was to the public interest to grant them incorporation. This is a further and severe blow to the prosecution of doubtful schemes. Two Gas Companies obtained authority to become suppliers of electricity—viz., the Ascot District Gas and Electricity Company (which is the extended title of the Company), and the Brixham Gas Company. The session again confirms the necessity for an early revision of the Gas-Works Clauses Act, in regard to which a suggestive article appeared in our columns from the pen of Mr. V. Balfour Browne.

The prosperity which has continued to attend the gas industry is not—speaking generally—due to any great extent to increase of consumption, which is still affected by the displacement of flat-flame burners by the incandescent mantle, although mild and open weather throughout the greater part of the winter months has also played an important part in checking consumption. That there is great potentiality of consumption is apparent from the very marked increase of output which occurs whenever there is an appreciable fall of temperature; and there is no doubt whatever that history would repeat itself in the shape of record outputs in the event of frost and fog occurring in the height of the busy seasons. It is noteworthy that most of what additional consumption there has been has fallen to the lot of the Suburban Companies whose districts comprise the outskirts of the populous region. This indicates as clearly as anything can do the trend of the population outwards. At the same time, several good increases have been reported from the Provinces; and the first half of the year the Gaslight and Coke Company did considerably better than they have done of late years. The vigour with which the competition with electricity is now pressed is exemplified by the reports on all sides of the displacement of electricity by gas. It is stated that in the district supplied by the Gaslight and Coke Company already in nearly 1000 cases gas has entirely taken the place of electricity; while in more than 1000 other cases, electricity has been largely superseded by gas. The South Suburban Company inaugurated the operation of their new Act by taking off the 1d. per 1000 cubic feet which was added to the price of their gas last year. Other reductions have been made by various gas undertakings, principally affecting the Provinces. The low prices charged at Widnes and Sheffield are particularly noteworthy.

A somewhat anomalous feature of the coal market has been the rise in the price of Durham and South Wales coal unaccompanied by a corresponding rise in the product of the great Midland coalfields. This condition of things could, however, be but temporary; and, as the year closes, the process of levelling-up seems to be almost complete. A 5 per cent. increase in wages comes into force early next year in the Midlands. The abolition of the coal export duty which was foreshadowed last year, became an accomplished fact on Nov. 1. But the relief afforded to users of English coal abroad is to a considerable extent, if not wholly, counterbalanced by advances in values and freights; Australian coal being also put at higher figures. In connection with the remission of the coal tax (which came into operation on April 19, 1901), it is of interest to note that it yielded in 1905-6 £2,183,973; and a total from the date of its introduction of £11,125,073. The prices of other materials used in gas-works have been against buyers, though not to any great extent—those of tin, lead, and copper excepted. A sweeping reduction in the price of thorium (from 53s. to 27s. per kilo., less certain discounts), made by the principal dealers, with the object, it is assumed, of maintaining control of the market, enabled manufacturers to lower the price of mantles, which can now be obtained at very reasonable prices.

As regards residuals, the market for sulphate of ammonia has been rather weak throughout the year; and prices leave off lower than last year's. Tar products have also, on the whole, a diminished value; the price of tar having followed suit. A considerable quantity of this product is now used for road-making; the increasing use of motors making a smooth and even road surface a necessity. This may result in higher prices being obtained for tar in the near future. Gas oil has remained fairly steady, but with an upward tendency. The market for coke has been much improved by increased activity in the cement trade.

The question of electricity *versus* gas for street lighting has continued to occupy the attention of lighting authorities; and it is satisfactory to know that, whenever this has been decided upon merits, the verdict has been in favour of gas. Unfortunately, however, many local authorities are deeply committed to electricity; and where this is the case, their action is too often biased in its favour. At the last half-yearly meeting of the Gaslight and Coke Company, Mr. Corbet Woodall—who has succeeded the late Sir William Makins in the Governorship—commented upon the action in this respect of one Borough Council, having jurisdiction within the Company's area of supply. In this important case, the Lighting Committee of the borough, after very carefully considering the matter, reported in favour of incandescent gas, as against electric street lighting, as the most efficient and least costly. The Borough Council, however, who are the owners of the electricity works, for which they paid a huge price, rejected the recommendation of the Committee, and decided upon electric lighting, on the ground that "loyalty" to the borough's own undertaking must outweigh every other consideration. When this is the case, can it be wondered at that there exists so strong a feeling against municipal trading? This, as Mr. Woodall pointed out, is only one case out of many of a similar kind. In refreshing contrast to it may be recalled the independent attitude of the City of London with respect to this question. The success of incandescent gas lighting in Queen Victoria Street, Fleet Street, and the Monument street area, encouraged the Lighting Committee to recommend a further supersession of electricity by gas in other areas, which was agreed to by the Court of Common Council with only two or three dissentients. Mr. Morton, M.P., supporting the recommendation, observed that the business of the Court was not to consider either the Electric Light Company or the Gas Company, but only what was the best illuminant for lighting purposes, and whether they could make it pay. That is the spirit in which the gas supply industry desires this question to be approached everywhere, and on all occasions. Nothing better can be wished for than a fair field and no favour.

Among the subjects of litigation during the year, one expects—almost naturally—to find that of the steam-roller belonging to the Council of County Dublin. To such an extent has this been breaking the mains of the Gas Company that the latter were constrained to proceed against the Council for damages, which the Irish Master of the Rolls decided they were entitled to, with costs, in all cases brought before him except one, which was not proved to his satisfaction. Several appeals against new assessments for rating purposes were successfully prosecuted. Among these was one by the Cardiff Gas Company, against an assessment of their property in five country parishes outside the city, which was 32·26 per cent. higher than the old one, though the profit made by the Company had only increased by 11 per cent. Among other successful applicants for relief in this respect was the Ipswich Gas Company. Quite a number of Companies, too, by pacific means have obtained reductions of assessments—an important feature for consideration having been the capital expenditure on prepayment meters, fittings, and cookers. The Bristol Gas Company were upheld by the Bristol Magistrates in their refusal to supply gas through a defective service, and in requiring a new service to be laid as a preliminary condition to such supply.

The Commercial Gas Company were again the defendants in an action brought against them for damages resulting from an explosion said to have been caused by defective fittings of a prepayment meter. The case was tried last year, when the jury disagreed. This time the jury returned a verdict in the Company's favour. The appeal of the same Company against the decision of the Police Magistrate on a summons taken out by the Poplar Borough Council against them for the cost of filling in and making good the ground affected by their excavations, was dismissed. This case, which is of considerable interest in connection with the question of liability for the reinstatement of roads, was reported in the "JOURNAL" for May 9, 1905. In the case of *Creasey and Wife v. South Metropolitan Gas Company*, the appeal of the plaintiffs against the decision of the Lambeth County Court Judge was dismissed with costs. This was an endeavour to obtain from the Company damages, assessed at £22, resulting from the imperfect reinstatement of a road after it had been opened by them. The reinstatement was, it appears, done by the Borough Council, under the provision in section 114 of the Metropolis Management Act, 1855; the question being, whether the Company did not remain liable under section 10 of the Gas-Works Clauses Act, 1847. This question was decided by Mr. Justice Kennedy in the negative. A claim for well pollution preferred by Messrs. James Muir and Sons against the Edinburgh and Leith Gas Commissioners, resulted in the Commissioners being ordered to pay £3730 and expenses. This judgment was appealed against; and the appeal is pending. The case of *Fletcher v. Mayor, Aldermen, and Burgesses of Birkenhead* was similar to that of *Jordeson v. Sutton, Southcoates, and Drypool Gas Company*, which was tried a few years ago. The defendants had sunk a well, and the allegation was that the pumping therefrom injured the land and premises of the plaintiff about 180 yards away. Judgment was given for the plaintiff. The Corporation appealed, but in vain.

The Ilford Gas Company have already been congratulated in these columns for their successful resistance to the various actions that were brought against them for damage alleged to have been done to houses and property in their district by the flooding of the river said to have been caused by their operations. In the action brought by the East Ham Corporation, £7520 was originally claimed. This at the close of the case was reduced to £747; and the Official Referee awarded only £120. In like manner, the claim of the Ocean Accident and Guarantee Corporation for about £10,000 was dismissed with an award of £156 15s. Other extravagant claims were similarly dealt with. The Tottenham and Edmonton Gas Company were summoned for an excess of sulphur in their gas, and were fined 10s. in one case; other summonses being dismissed. This, it may be expected, is the last that will be heard of proceedings of this vexatious kind, since freedom from sulphur restrictions is now almost universal. The New Inverted Incandescent Gas-Lamp Company were unsuccessful in an appeal against the decision of Mr. Justice Joyce, dismissing their action against the Globe Light Company, Limited, for infringement of their patent. The Portsea Island Gas Company settled an action brought against them for fouling a stream of water by effluent from their gas-works. In the case of the *Hastings Tramways Company v. Hastings and St. Leonard's Gas Company*, the plaintiffs sought to restrain the defendants from proceeding further with an arbitration in connection with a disturbance of the gas-mains, consequent upon the construction of a tramway by the plaintiffs—the action being brought under the Tramways Act, 1870. The application was refused and the arbitration proceeded, with the result recorded elsewhere. A summons taken out by the Gaslight and Coke Company for recovery from a prepayment consumer of money which had been stolen from the cash-box of the meter was dismissed by the Magistrate (Mr. H. J. Biron) on the ground that the money was paid by the consumer when he put it into the box, and that it could not be again recovered from him. The proceedings in respect to the Kent County Gaslight and Coke Company, for the removal of names from the register of shareholders and the return of the money subscribed for shares, have already been mentioned.

The technical work of the year has been highly interesting. Another very successful meeting was held by the Institution of Gas Engineers, under the presidency of Mr. Charles Wood, of Bradford, whose excellent address turned largely upon the idiosyncrasies of municipal gas-works management. A praiseworthy feature of the meeting was that all the papers provided for it were not only read, but also fully discussed. It is very desirable that the example thus set should as far as practicable be followed; for it is a disappointment no less to the audience than to the reader of a paper when insufficient time is given for the discussion of it, or (what has happened on more than one occasion) when a paper is shelved for want of time to bring it forward. Never-

theless, it cannot always be an easy matter to estimate the probable duration of a discussion upon a particular subject. The special fund for which subscriptions were invited by the Council from gas companies and local authorities owning gas undertakings, for the purpose of providing for investigations and other objects affecting the gas industry, only resulted in a total amount of nearly £600 being subscribed. It is to be regretted that the response was not a more substantial one, since there are many ways by which, with the aid of such a fund, the Council could act with advantage to the gas industry; there being, moreover, no other body more competent to undertake the work in contemplation. The meagre support which they have so far received in connection with this matter cannot but be regarded as a standing reproach to those concerned; for it is, as we have shown in the "JOURNAL," in painful contrast to the confidence that is reposed in the French and German Associations which similarly represent the gas supply industry in their respective countries. The various District Associations have continued to do very useful work. Practically all of them are now affiliated with the Institution, on the Council of which they are represented, entirely to the satisfaction of all concerned. Unfortunately, the Southern District Association has had to bring to a close for want of funds the naphthalene inquiry which was being pursued with a very reasonable prospect of success. Their final report, however, is a valuable one, and cannot fail to be of considerable assistance to any student of the subject. Some useful experiences at Sheffield as to the treatment of gas by oil-washing processes for the elimination of the naphthalene trouble were supplied in an article by Mr. Hanbury Thomas. Good accounts were also heard of the work being done by the carburation system. Also in connection with the naphthalene question, Mr. William Young and others made valuable communications to our columns; and not the least important contribution came from the Michigan Association, in the shape of a report incorporating the results of the labours of Professor A. H. White and his co-workers.

The now numerous Junior Associations have throughout the year been much in evidence in our columns. The new Victorian Association held a very successful meeting at Melbourne. In the course of the year, too, greater recognition has been made of the fact that in the cause of progress, Science cannot be divorced from practical work; and in this connection, welcome is given to the establishment of a Professorship of Fuel at the Leeds University. The material support of the industry has been solicited for this by Sir George Livesey, Mr. Thomas Newbigging, and others; and it deserves the countenance of all who have the welfare of the industry at heart. An essential for its future is a body of well-equipped men. Another matter affecting aspirants for positions in the gas industry that has to be noted as an event of the year, is the widespread dissatisfaction that was expressed with the "Gas Manufacture" papers set for the examinations of the City and Guilds of London Institute. This evoked a great deal of "Correspondence," as did also the question of the status and salaries of engineers and managers in the gas industry. If those responsible for the control of gas undertakings want to attract good men to their service, and to get excellent management, there must not be niggardly treatment.

In technical matters there is not anything of a startling nature to record, but steady all-round progress has been made. How to produce and sell gas cheaply continues to exercise the minds of gas managers of whatever degree; they being urged thereto not only by the hope of increasing their profits, but also by the stress of competition. Suction gas-producers have apparently come to stay; and it is only low-priced gas that can check their advance. Doubtless the most important contributor to the latter during recent years has been reduction of capital charges; but this is no argument against the endeavour to bring down the cost of manufacture. This is a matter of increasing difficulty, chiefly in consequence of more exacting labour requirements, which affect not only gas-works costs, but also the price of the raw material—coal. It is, however, satisfactory to know that the upward tendency due to this cause has been largely if not entirely counteracted by the application of labour-saving appliances, the effect of which has, on the whole, been highly beneficial, although not in every case equally apparent. In its bearing, however, upon the problem of how to make cheap gas, the advent of low-grade gas, together with the Carpenter test-burner, is all to the good, not only directly, but indirectly, inasmuch as it secures to the gas manager that greater freedom which it is so necessary he should have in order to obtain the best results. Already this greater freedom is yielding good fruit in the shape of improved carbonizing returns, which, so far as they are legitimately obtained, cannot but tend to greater economy of manufacture. The philosophic doubts which were expressed by Mr. James Paterson in the paper he read at the autumn meeting of the Southern District Association of Gas Managers, as to the advantage of high makes per ton, sounded like a faint echo of a far-off controversy on the same subject. Then a production of about 10,000 cubic feet per ton was regarded as satisfactory; but now one of 11,000 cubic feet and upwards is demanded, and 12,000 cubic feet appears to be the goal towards which gas manufacturers are now steadily advancing. Much, of course, turns upon the quality of coal, but more, we are disposed to think, upon carbonizing arrangements. At the same time it is beyond dispute that there is such a thing as finality in regard to the quantity of gas to be obtained from a ton of coal; but every reduction of illuminating power puts finality further from view. There is, in point of fact, a steady advance in progress towards the supply of gaseous fuel; and it may be as well for this advance to be by steps instead of by leaps and bounds. Nevertheless any process which offers the possibility of the production of cheap low-grade gas is certain to receive very careful consideration.

Great curiosity has been aroused by such information as has been available with regard to the Woodall-Duckham vertical retort, the development of which has been proceeding during the year with, it is understood, hopeful results. The same may also be said of the Dessau system of vertical retorts, which is favoured by our German friends, and is now being somewhat considerably adopted by them. The excellent papers read by Herr Körting and Mr. Thomas Glover at the meeting of the Institution of Gas Engineers were very clear statements of the position of this question at the present time. Brilliant contributions to the literature of the subject were also made in our columns by Mr. William Young and by Mr. W. R. Herring. Cleethorpes and Guildford yielded useful experiences; and now trials are being awaited of the Young and Glover retort. But, withal, horizontal retorts are by no means dead. On the contrary, they still show signs of a very vigorous existence, and improvements in stoking machinery continue to occupy much attention. The Fiddes-Aldridge simultaneous drawing and charging machine has made a very interesting *début* at Liverpool; while the system of discharging by means of a pusher is distinctly and deservedly growing in favour. The West and the Dempster projectors are vieing for favour with the De Brouwer. Mention of these machines serves to remind of the recent growth of electric driving in gas-works, upon which Mr. C. F. Botley made an instructive communication in the "JOURNAL."

A contribution to the problem of high-pressure distribution was furnished in our columns by Herr Körting, in regard to the application of this system for the supply of certain suburbs of Berlin. In New York, there is in course of erection at the new Astoria Works of the Consolidated Gas Company a gasholder which, when completed, will be the largest in the world. It is to contain 15 million cubic feet of gas, and will measure 300 feet diameter by 260 feet in height when fully inflated. It is the first of a series of six of the same size which it is intended eventually to erect. Manchester is going to take the lead in the Provinces in size of gasholders, with one having a capacity of 10 million cubic feet. Referring to gasholders, it may be mentioned that Mr. William Gadd described in our columns his latest improvements in columnless guiding. Of extensions of gas-works in this country, the most important was the completion of the second section of the new Granton works of the Edinburgh and Leith Gas Commissioners, under their able Engineer, Mr. W. R. Herring. Undoubtedly it is a source of exceeding gratification to Mr. Herring and the Gas Commissioners, and also to the gas consumers of the important places served, that these large new gas-works have proved a great financial success. Notwithstanding their necessarily large cost, the considerable saving they have been the means of effecting in the expense of manufacture has enabled the additional charges to be met entirely out of revenue; while at the same time the price of gas has been reduced. New gas-works at Coventry, and extensions at Hull, Leeds, and

Tottenham, are among the notable engineering works of the year.

In the production of gas lighting and heating appliances, there has been considerable activity throughout the year. The inverted incandescent burners have "caught on," and there is now quite a variety of them to select from. A feature of the year has been the extensive application of inverted burners to the street lighting of Edinburgh. Improvements in high-power and ordinary incandescent gas burners and lamps have continued to come to the front; and excellent duties are now obtained. Mantle inventors have been busy in the effort to evolve mantles with enhanced durability and light-giving power; and an article of exceptional interest in the current issue of the "JOURNAL" treats of another new mantle, of which great things are expected by our friends abroad, and others in this country who have had an opportunity of testing the claims in regard to it. Gas-fires continue to be improved upon, chiefly in the direction of better regulation of the gas and air supply, and some of these are now models of economy as regards gas consumption. An interesting report on the thermal efficiency and hygienic value of gas-stoves was made by the Coal Smoke Abatement Society. This, although by no means the last word on the subject, has had the effect of clearing the air with regard to many of the objections that have been urged against the use of gas-fires from a hygienic point of view. A valuable paper on the same subject was also submitted by Dr. Rideal at a meeting of the Royal Sanitary Institute. The discussion which followed the reading of the paper elicited some rather remarkable views on the matter from medical men present. A reference to it was also made at the meeting of the Society of British Gas Industries by Mr. Charles Hunt, who took the view that there should be no greater reason to apprehend mischief from the products of combustion when gas was used for heating than when used for lighting purposes. It is, no doubt, all a matter of ventilation; and there ought to be no necessity to depend upon fireplaces and flues for this purpose. The problem of how to warm a room without a flue is already solved by the oil-stove people, who make no difficulty about allowing the products of combustion to enter the room, whatever be the quantity of carbonic acid produced. In connection with the popularization of gas-fires and cookers, the growth of the movement whereby the co-operation of ironmongers is secured is worthy of encouragement.

We have already mentioned the unsettled feeling that exists regarding municipal finance and expenditure generally. The municipal monetary position has given much concern to financiers; and they are not inclined to relax their views as to the interest that municipal authorities shall pay for loans for trading ventures. Strong believer as he is that municipal usefulness is still far short of its limits, Mr. John Burns, as President of the Local Government Board, is apparently determined to have municipal accounts so ordered that they shall be above suspicion, shall have a facial accuracy, and shall be free from entanglement. These are conditions that exist at the present time in the accounts of but few municipalities. If Mr. Burns, through the Committee he has appointed to inquire into the matter, produces reformation in this one respect, his appointment as a Minister of the Crown will not have been in vain. His insistence on correctness in detail has had dismal results for certain local authorities in connection with their electricity undertakings. There are numerous places, too, where the municipal management of trading concerns requires rather a large amount of reformation. Over the administration of the Gas Department, there has for some months been feverish excitement at Nottingham. The management of Mr. J. H. Brown was deliberately impugned by the late Chairman, who sought hard and persistently to get him to resign. So great did the agitation become, that a Special Investigation Committee was appointed, who held an inquiry in private, and absolved Mr. Brown of the imputations against him. Discussion of the matter ran high during the municipal elections, and acerbity hardly describes the tone that was adopted in some quarters. The ratepayers have a feeling that something they ought to know is being hidden from them; and there has been a demand for the publication of the evidence given before the Investigation Committee as well as for a Local Government Board inquiry. With regard to the proposed publication of the evidence, it only requires the sanction of those who were opposed to Mr. Brown to give satisfaction to the demand; and as to the Local Government Board inquiry, Mr. Burns does not seem to regard the matter as one coming within the ken of his department. However, the agitation is not to cease; and a petition is being promoted for presentation to the House of Commons. This Nottingham scandal, for it has been nothing less, raises a question as to control. There seems to be no one who can take any authoritative action in regard to the maladministration of municipal concerns; but let a private company step never so little over their statutory bounds, and the local authority will bring all the applicable machinery of the law to bear upon them. What has happened at Nottingham, too, will not tend to make municipal service more attractive.

With regard to the manufacturing section of the industry, the Society of British Gas Industries have held successful and useful meetings during the year. Two great points of satisfaction to the members have been the acceptance by Mr. Dugald Clerk of the presidency of the Society, and the holding out of the hand of fellowship to them by the Institution of Gas Engineers and the District Associations. The President of the former (Mr. Charles Hunt) and the Honorary Secretary (Mr. James W. Helps) were present, with a representative number of other members of the gas profession, at the meeting and dinner of the Society a few weeks since; and there is every prospect of a working relationship between the bodies when matters of mutual concern are to the front. Closely related to manufacture has been the continued discussion during the year on the question of Patent Law amendment, the presence of the necessity for which never seems to leave us for very long. In all branches of commerce, the Prevention of Corruption Act, which comes into operation next week, has created some sensation on account of its comprehensive character, the making criminal of the acts of offering or asking for gifts or consideration of any kind and their giving or receiving, where there are business relations, and the heavy penalties —both imprisonment and fines—attaching on conviction. In America, too, President Roosevelt is leading in the endeavour to cleanse the Augean stable of corruption in the public and business life of the great nation of which he is the distinguished head. The prosecution of the Standard Oil Company at his instigation, and the exposure of its methods, appeal particularly to readers of the "JOURNAL;" and the further proceedings in connection with it will be followed by them with special interest and attention.

It is with satisfaction report can be made that fatal accidents in gas-works have been few during the year. Beckton lost three workmen, on various occasions. There was the loss of a life through an explosion in a purifier-house at Coventry, through the use of a defective lamp; fatalities occurred in connection with the coke-conveying plant at Nechells (Birmingham) and Croydon; and there was a gasholder dismantling accident at Ilfracombe. The revised regulations of the Home Office in connection with the safety of workmen in relation to locomotives, railway waggons, and railway sidings, have been published; and they are more conformable with justice than in their original shape. A Bill for the notification of accidents was introduced, and it received the Royal Assent on Friday. Instructive information has been published during the year respecting the accidents fund of the South Metropolitan Gas Company; and Sir George Livesey has also borne testimony to the carefulness of the old workmen. There were several explosions and suffocations due to gas during the year. At Southampton, the Corporation had to satisfy claims for personal damage occasioned by an explosion brought about by the use of a steam-roller. Certain of the year's explosions have been traced to the disturbance of roadways and consequently of gas-pipes; and there is also the facility that is now given for the lodgment of gas underground, through wire culverts and inspection chambers. The evidence of Mr. G. F. L. Foulger before the Royal Commission on Motor Cars was full of interest—more particularly in view of his unique experience in the Metropolitan area. It is rather amusing to find that the London County Council have been proposing to take powers to "prevent" dangerous leakages of gas by securing more supervision over the laying of gas-mains. They have strange notions at Spring Gardens. The Gas Companies themselves take good care to make a tight job of the laying of their mains; and their own supervision in this respect is beyond reproach. The Gas Companies are not at all favourable to the distribution of their commodity in the air or other place where it is not paid for. If now the busybodies at Spring Gardens would get powers to prevent

the disturbance of, and injury to, gas-pipes after they have been laid, they might do some good. Of course, there have been one or two lamentable accidents that cannot well be explained; but the bulk of the suffocation cases, excepting where the evidence showed distinctly the murderer or the suicide, have been due to carelessness, loose taps, water-slide chandeliers, or searching for leakages with lights. But a most disgraceful thing was the suffocation of three children at an East End public-house through a joint having been made by a piece of india-rubber tubing. It is a matter for congratulation, however, that considering the immensity of the business done in gas supply, accidents should be so few. Suffocations deliberately produced ought not to be, as they have been, used to discredit gas. In those cases, if it was not suffocation by gas, it would be something else.

The year has witnessed an unusually heavy list of changes in connection with the *personnel* of the industry—both in directorial and in official capacity. Remarkable was the change made in the Court of the Gaslight and Coke Company. Death removed Sir William Makins, the Governor; and continued ill-health forced upon Mr. John W. Field the necessity of retirement. We have previously said all that these events demanded; but the deplored causes that produced the vacancies have been the means of introducing what has long been required at Horseferry Road—fresh power and new blood into the administration. Fittingly, the choice of the Board of a successor to Sir William Makins fell upon Mr. Corbet Woodall; and the two vacancies were filled by the appointment of Mr. Douglas Walker, K.C., and Mr. H. J. Waterlow. The "shuffling of the "cards" in connection with official positions has been so frequent that we cannot do more than allude to a few of the changes, the importance or other special point associated with which suggests reference. A feature of the official life of the gas industry are the many instances of long service that have been recorded. Mr. James Stelfox has retired after half-a-century's service, and Mr. William North, after 40 years. Mr. Thornton Andrews, of Swansea, has been celebrating his jubilee; Mr. Benjamin Green, the jubilee of his connection with the industry, and forty years with the Mitcham and Wimbledon Gas Company. Mr. W. D. Child, of Romford, has had recognition made of his thirty years' service; and Mr. John Carter at Lincoln, of his quarter of a century's service. In addition to the resignation of Mr. Stelfox and Mr. North (who are respectively succeeded by Mr. R. Sharpe and Mr. C. H. Webb), Mr. R. O. Thompson has quitted the official headship of the Melbourne Gas Company, and the reins of office have been, subject to a little later confirmation, taken up by Mr. P. C. Holmes Hunt. Mr. Matthew Leaf has resigned his position at York, and Mr. Sidney E. Stevenson follows him. Mr. G. W. Anderson has left the service of the Primitiva Gas Company, and Mr. B. F. Browne has taken up his duties. Mr. F. W. Chamberlain has returned, or is returning, home from Bombay; and Mr. A. R. Burch has gone out to succeed him. Mr. William Parlby has vacated office at Hereford; and has been followed by Mr. W. W. Townsend. Other resignations are Mr. W. Newbigging, from Macclesfield; Mr. Henry Peaty, from Burslem (his successor being Mr. Edward Jones); Mr. E. E. J. Anderson, from Middleton; and Mr. A. R. Cawley, from the Rhymney and Aber Valleys Gas and Water Company. Mr. William M'Crae has been compelled, on account of ill-health, to relinquish the position of Gas Engineer and Manager to the Falkirk Corporation. As had been concluded would be the case, Mr. Arthur Bromley has definitely been appointed to succeed his late father at Batley; and we confidently hope to hear shortly that Mr. R. S. Ramsden has been selected at Burton-on-Trent to succeed his late father, whose work he diligently carried on all through the long and most distressing illness that his father suffered. Last to be mentioned, but foremost in importance, have been the changes made in the station staffs of the Gaslight and Coke Company, which have put Mr. J. H. Reeson in the most distinguished position at Beckton, while Mr. Iago has been transferred to the charge of the St. Pancras, Shoreditch, and Haggerston stations. In the gas apparatus and plant manufacturing world, the retirements of Mr. John G. Glover, of Messrs. Glover and Main, Limited, and Mr. Alfred Featherstone, of Messrs. C. & W. Walker, Limited, were announced.

The shadow of death has rested gloomily over the industry; but the list of those who have "crossed the bar" direct from active service is shorter than it has been our unfortunate lot to chronicle on some former occasions. Mention has already been made of the death of Sir William Makins. Only last week we had to record the loss of Mr. F. L. Ramsden, of Burton-on-Trent; and at other times during the year of Mr. J. S. Reeves, of Bilston, Mr. James Wadeson, of Windsor, and Mr. Evan Jones, of Aberdare. The ranks in Scotland were thinned by the removal of men of much individuality. Mr. James M'Gilchrist, Mr. Samuel Stewart, Mr. Jesse Hall, and Mr. A. S. Robertson were all called from the activities of this life. Some of the men who had stepped from the official ranks and were taking their rest, finally retired from the earthly scenes in which they had in latter years taken their part. We refer to Mr. Robert Morland, Mr. Robert P. Keys, Mr. W. B. Wright, and Mr. Frederick Russell. Men whose names have also been honourably linked with the industry in one capacity or another, but whose life's work has been closed during the year, are Mr. C. R. Bellamy, Professor A. J. Wanklyn, and Mr. Henry J. Chaney (of the Standards Department). We mourn with the French Society the loss of their learned and distinguished colleague, M. Auguste Lecomte. From other spheres, other names well known and time-honoured in the industry have had to be enrolled in the list of the departed. They are Sir Richard Tangye, Mr. Joseph Aird, Mr. William Clapham, Mr. George King Harrison, and Mr. J. R. Wigham.

We have finished our review of the year. Regarding in the whole all that has transpired, there cannot be two opinions as to there being cause for profound thankfulness at—the acuteness of competition notwithstanding—the prosperity and the progress achieved. Science and invention have been busy on our behalf; and on all sides the search for economy in structure having regard to durability and service, in material, in production, and in utilization in relation to the efficiency realized, is being vigorously prosecuted. Handiness for many purposes, reliability, and cheapness are all in favour of the gas industry in the rivalry for business; and there is ground for gratification over the maintenance of a magnificent popularity. Save for a little uncertainty as to markets, we feel a large amount of confidence as to the success of the industry in the coming year. For all our readers, and for all engaged in the industry, we earnestly wish

A Full Measure of Prosperity and Happiness in 1907.

Expiration of the Welsbach 1893 Patent.

Since the reorganization of the Welsbach Gas Company, the present Directors have taken no steps to defend in any way the 1893 mantle patent, but have, with a large measure of success, entered into open competition in a true commercial spirit. The 1893 patent was the one upon which the Company, in other days under other administration, relied in their expeditions in the Law Courts against infringers, with very poor effect excepting in so far as law expenses went. In view of those, for the gas lighting world, lively and tumultuous times (in which the "Journal" took its part, with subsequent events proving the truth of the statements made, and the righteousness of the cause espoused), it is of historical interest to note that the patent expires on the first Thursday in January. The abstract of the specification of the patent that appeared in the "Journal" on March 13, 1894, was headed "Incandescent Gas-Burners—Imray, O.; communicated from Moeller, J., of Westminster. No. 124; Jan. 3, 1893." It will be noticed that the name of Baron Auer von Welsbach does not appear here; but the name of Mr. Julius Moeller does. It would be found, if ever the true history of this patent was written, that "thereby hangs a tale." However, Jan. 3 sees its expiration; and it will live only in memory as the centre of much struggling and contest that yielded good to no one.

The Trials of Suction-Gas Plant at Derby.

In the last number of the "Journal," it was notified that the report on the trials of suction-gas plant carried out, under the auspices of the Royal Agricultural Society of England, at Derby last summer, had been issued; and we give elsewhere extracts from the text, and reproduce some of the tabulated results. The Society has for some time identified itself with suction producers

used in conjunction with gas-engines; the first exhibit having been made by Messrs. Crossley Bros., Limited, at the show held at Cardiff in 1901. In 1903, at Park Royal, a suction-gas plant was shown by the Dowson Economic Gas and Power Company, Limited, which was a combination of the Company's producer with a "National" gas-engine. Messrs. Crossley also exhibited a suction-gas plant at this show. In 1905 three plants were entered; and last year the number had risen to four. This increase, taken in conjunction with the claims set forth by the makers in regard to the reliability and economy of the plants, led the Council of the Society to have the further trials which are the subject of the report. No less than fourteen plants were entered, and many others were exhibited; but three were withdrawn during the tests. The main object of the trials was to determine whether suction-gas plants could be relied upon to work for agricultural purposes with the same degree of freedom from breakdowns as steam-engines, and with the small amount of attendance required by an oil-engine. The conclusion arrived at was that, though less manual labour is required than in the case of a steam-engine, more intelligent care is necessary to ensure the production of gas of good quality. The feature of the report of special interest to our readers is the table giving particulars of the full-load trial with coke. It shows considerable uniformity in the consumption figures, and the order of merit is nearly the same as in the anthracite trials. But the reporter (Captain H. Riall Sankey, R.E.) says coke is a more difficult fuel than anthracite to deal with in suction producers. At the same time, it is more easily obtainable, and, except for one drawback, will generally prove cheaper in use. The drawback referred to is that it varies considerably in regard to its freedom from tar; and Captain Sankey suggests that when the plants under trial become more general, as they no doubt will, an arrangement should be made whereby some standard of permissible percentage of tar can be ensured. This is a point to which the attention of gas managers may be usefully directed.

The Federated Districts Coal Conciliation Board.

We are pleased to see that, after lengthy negotiations, the Conciliation Board for the regulation of wages in the Federated Mining Districts of England and North Wales, which would have terminated on Jan. 1, has been renewed for a further period of three years. As was recorded in the "JOURNAL" as long ago as last October, both masters and men were fully agreed as to the desirability of continuing the Board; but nevertheless there were differences of a substantial nature to be arranged. The men asked for an increase of the present minimum from 35 to 40 per cent. above the 1888 standard, the making of the minimum the basis of a new 1906 standard wage, and the signing of the agreement for a period of three years. They also asked for an advance of 5 per cent. in wages from Jan. 1 next. The owners, on the other hand, objected to the increase of the minimum wage and to the fixing of a new standard; and they wished the agreement to be for a longer term than three years. They offered an increase of 2½ per cent. in wages. However, when both parties to a discussion are anxious to come to an understanding, there are few difficulties that cannot be surmounted; and in the present instance this has been done by means of some mutual concession. The owners have consented that the increase to be made in the wages next month shall be 5 per cent., instead of the 2½ per cent. they offered previously; and that the agreement constituting the Board shall be operative for three years in place of the five years which they desired. On these two points, therefore, the men gain all they asked for; but to secure so much they have had (as is quite fair) to give way somewhat on another matter. The minimum rate of wages is to be 37½ per cent. above the 1888 standard, instead of the 40 per cent. which the men in the first place stipulated for. It is, however, particularly stated that "the advance of 5 per cent. in wages is given in the belief that there is a rising market, and in consideration of a renewal of the Conciliation Board." There are, of course, some minor clauses; but this is substantially the basis of the new agreement, which proves once more how much can be accomplished by friendly discussion. It may be pointed out that the agreement is to be terminable, on notice from either side, "in case of the compulsory limitation of the hours of labour." Does this new clause presage, as is hinted at in some quarters, the early placing on the Statute Book of an Eight-Hours Act? This must be for the future to decide.

WATER AFFAIRS.

The Principal Events of the Year.

THE close of another year imposes upon us once more the duty of reviewing the principal events connected with water supply which have occurred during its course. The task will not be an arduous one, for no works of great magnitude have been achieved in this country since our last retrospect appeared. But if the year has not been marked by any conspicuous event, it has been by no means devoid of interesting features. After a dry December, the New Year came in with very cold weather; but it did not last long. There came a break with a fall of rain on the second day; and a week later a violent thunderstorm burst over London, accompanied by a perfect deluge. Rain in the Provinces was welcome, as it replenished stores which had run low, notably at Leicester. But a dry summer again brought the town, as well as others, into difficulty. Relief eventually came, however; and, as will be shown by our review, steps have now been taken to prevent the recurrence of the troubles attending a shortage of water. Ample rains in the autumn compensated very largely for their absence during the summer.

It will, perhaps, be advisable to begin, as in previous years, with the Metropolis, and glance at the work of the new body which has been entrusted with its water supply. The first meeting in the year was characterized by a somewhat remarkable announcement. The Chairman (Sir Melvill Beachcroft) read a letter from Sir Edward Fry, one of the three Arbitrators under the Metropolis Water Act, 1902, expressing his intention of relinquishing £3081 of his fees, and asking the Board's acceptance of the amount. At the succeeding meeting, the Chairman announced that a similar communication had been received from Sir Hugh Owen, another of the Arbitrators, who forwarded a cheque for £1140. These generous acts were duly acknowledged. Then, turning from personal to business matters, the Board were made aware that the powers for the construction of a much-needed reservoir at Honor Oak had lapsed, and they decided to ask Parliament to help them out of their difficulty by permitting the addition of a clause in the Bill then before them. This was done; three years being allowed in which to complete the work. Application had been made by a number of Local Authorities to have the water-rates levied by precept upon them, and collected with the local rates; but, upon the advice of the Comptroller, the Board declined to put forward any scheme on the subject. At the same time, the Appeal and Assessment Committee turned their attention to the question of a revision of the charges for water as the result of the quinquennial valuation; and the result of their deliberations was made known later in the year. Communications passed between the London County Council and the Board in regard to the supply of water to fires; but no definite conclusion was arrived at. Early in the spring the Board had a special meeting to consider their Bill to sanction some extensive sewerage and other works in the Lea Valley; and it was decided to abandon them, and to proceed with the rest of the Bill. In April, the second annual report appeared; and just before the Whitsuntide recess, the abstract of accounts for the year ending March 31, 1905, was published, and showed a deficiency of £9550. Shortly afterwards, the estimates for 1906-7 were presented by Lord Welby, the Chairman of the Finance Committee, who pointed out that the margin between income and expenditure was very close, and urged upon the Board a close examination of all proposals for the outlay of money, if their policy was to be one of "no charge upon the rates."

At the final meeting held before the summer recess, the Board had submitted to them the results of the labours of the Appeal and Assessment Committee in investigating the question of the proposed adoption of a uniform scale of charges for water. The matter, however, was referred back to them for consideration in conjunction with the Finance Committee; and when members re-assembled in October, the principle of a uniform charge based on rateable value was adopted. Instructions were accordingly given for a Bill to be drafted, and notices for it and for one to confer some miscellaneous powers upon the Board duly appeared last month. Additional storage is to be provided in the Lea Valley and at Walton-on-Thames. In October the Board issued their third annual report, which presented the results

of their first complete year's operations. As a body, they have not been free from criticism during the year. The quality of the water and the adequacy of the existing sources of supply have alike been called in question; and the old suggestion that London should go to Wales for additional water has been brought forward. But it has been again conclusively shown that, by the construction of the necessary reservoirs, the present sources will be equal to the demands of the population of London for some time to come. The provision of this additional storage the Board, as shown above, have taken in hand. One gratifying feature of their year's work was the maintenance of the supply during a long spell of unusually hot and dry weather; and another, the decision of their employees, by 2888 votes to 49, against Trade Union terms and conditions. They may now be said to have got their house in order; and the further powers they are seeking in the Bills to be introduced next session will strengthen their hands in rendering the water supply of the Metropolis more efficient.

Turning from the Metropolis to the Provinces, the event of the year which calls for first notice was the completion of one section of the new works for the supply of water to Carlisle from Geltsdale. The scheme, as our readers may remember, had a chequered history, owing to difficulties with the Engineers; but it was eventually entrusted to Messrs. James Mansergh and Sons, under whose supervision it was successfully carried out. The ceremony of turning on the water was performed by Sir Benjamin Scott, the Chairman of the Water Committee of the Corporation, in the presence of the Mayor and a numerous company, representing practically all the principal trades and professions of the city, on the 16th of August. It now only remains to complete the reservoir, which will take about two years, when Carlisle will be ensured an ample supply of water for a long time to come. Another scheme successfully completed was that carried out by the Loughborough Corporation for affording an additional supply of water to the town from the Blackbrook. The reservoir and other works had taken six years to construct, and had cost £100,000. The ceremony of laying the last stone was performed by Alderman Joseph Griggs (the first Mayor of the borough, and one of its greatest benefactors) on the 12th of September. Much satisfaction was caused in Lincoln about the middle of March at the news that water had at last been struck at the deep boring at Boultham, which had experienced some vicissitudes, notably in the loss of the boring-tool. The brick shafting was completed to a depth of 1502 feet; and a small bore was made for 61 ft. 6 in. below this. It was there that water was tapped. At first the yield promised to be abundant and of good quality; but the latest accounts to hand are to the effect that the water is unfit for domestic purposes. The first section of the scheme for obtaining water from the Shimna River, in the Mourne Mountains, for the supply of Portadown and Banbridge, was opened in the summer. It had been carried out by the Urban District Councils of the two towns. The Denbigh Water Company brought into use in the spring an overflowing borehole in the Vale of Clwyd, the pumping plant in connection with which is worked by gas-engines. Waterworks erected by the Milton-next-Sittingbourne Urban District Council, new filters constructed by the Accrington District Gas and Water Board, and an additional supply obtained by the East Cowes Urban District Council, were inaugurated about the same time.

Several other schemes have been carried out during the year. Early in May, the President of the Board of Trade (the Right Hon. D. Lloyd-George) opened new water-works for the supply of Niven. A few weeks later, the Rhyl Urban District Council inaugurated a new reservoir which had been constructed at a cost of £26,000; and towards the end of August, one erected by the Weardale Water Company was available for service. About the same time, a water scheme was completed for the supply of Biggleswade and thirteen surrounding parishes, at an outlay of about £61,000. Early in October, the new works constructed for the supply of high-level portions of Colwyn Bay were opened by Miss Roberts, the sister of the Chairman of the Urban District Council. Towards the close of November, Lady Grey, the wife of the Chairman of the Malvern Urban District Council, inaugurated the additional supply of water which had been procured for the town at a cost of £20,000. This portion of our review must not be closed without recording the completion early in the year of the new Croton dam in connection with the great scheme of water supply for New York, begun more than thirteen years ago.

In addition to the works completed, schemes have been initiated during the year for improving the water supply in a number of towns. Birmingham and Coventry have come to an agreement for a supply by the former to the latter of water from the works at Whitacre. An arrangement of a somewhat similar character was under consideration by the Corporations of Liverpool and Birkenhead, whereby the borough could have an auxiliary supply from Vyrnwy; but it fell through, and the Birkenhead Corporation are going to carry out a large scheme of their own. The Runcorn Urban District Council, however, came to terms with Liverpool, and Vyrnwy water was turned into their reservoir on the 12th of February. Towards the close of the following month, a commencement was made with new water-works for Selby; and in the summer the North Warwickshire Water Company started main-laying operations to enable them to afford a supply of water to several villages in their area. Works of extension or improvement have been proposed, or are actually in progress, in connection with the supply of water to Alfreton, Axbridge, Belper, Berwick, Bolton, Burnley, Chesterfield, Clare (Suffolk), Dartmouth, Devonport, Dublin, Haltwhistle, Holywell, Ilkley, Lincoln, Lynn, Middlewich, Newtownards, Paignton, Penrith, Penzance, Shanklin, Teignmouth, Torquay, and Uttoxeter. Then, north of the Tweed, schemes have been under consideration for improving the water supply of Aberdeen, Blairgowrie, Clydebank, Dumbarton, Dundee, and Forfar; and a new supply was turned on for Irvine in the autumn.

Before leaving this subject, several incidental matters may be briefly noticed. In the first place, the Manchester Corporation decided to proceed with the laying of a third pipe-line from Thirlmere to meet the growing requirements of the city. Shrewsbury, on the other hand, has vacillated in a most remarkable manner over the question of the water supply of the town. After what is known locally as the "upland scheme," as distinguished from a river supply, had been agreed to by the ratepayers, a Bill promoted to carry it out, and the promotion of the Bill sanctioned in public meeting, the scheme was rejected by the ratepayers on a second poll. The result was that the whole of the Water Committee, with the exception of three members, tendered their resignations. Subsequently, the Town Council consented to the expenditure of a small sum to improve the quality of the river water and increase the pressure in the higher parts of the district. The Blyth Urban District Council sought power to purchase Lord Ridley's waterworks, with the view of getting a more reliable supply for their district; but the Local Government Board refused them a loan for the purpose. The Board also declined to grant an application by the Maesteg Urban District Council for leave to borrow a further sum of about £40,000 so as to complete a reservoir on which they have already expended nearly £30,000 without having met with any satisfactory foundation for the dam. At the end of October, a conference was held to consider a comprehensive scheme for conserving the water supply of Monmouthshire; but when the project was submitted to the County Council, it failed to secure the necessary majority to allow of steps being taken to carry it out. Acting under the powers lately conferred upon the Glamorgan County Council (referred to later), the Water Committee of that body have appointed Mr. R. E. Middleton to make a survey of available watersheds in their area. An important event of the year was the decision by the Leeds Corporation to abandon the construction of the Colsterdale reservoir in the Ure Valley, in accordance with the recommendations of their Water Engineer (Mr. C. G. Henzell) and Mr. Henry Rofe, who was specially consulted on the matter; and another was the rejection by the Portsmouth Town Council of a scheme for the purchase of the water-works, after a provisional agreement had been entered into, and the terms settled, between the Water Committee and the Company. The decision at Leeds was the sequel to some extraordinary disclosures in reference to the site of the reservoir which had been made to the Council by the Chairman of the Water Committee (Mr. J. H. Armitage); while that at Portsmouth was apparently mainly prompted by a desire not to burden the town with the heavy pecuniary responsibilities which the transfer would have entailed. Curiously enough, the question of purchasing the waterworks at Portsmouth has been before the town for about half-a-century; and it was quite thought that the transfer

would be effected this year. But it is preferred to leave the works with their original owners.

From works actually completed or in progress, we may pass to those which have recently been sanctioned. Brief mention of them is all that is necessary, inasmuch as the parliamentary work of the year in connection with water supply has lately been noticed. Dealing first with Companies, new works were sanctioned for Holyhead, and for the supply of several parishes in Sussex by the North Sussex Gas and Water Company. The Portsmouth Water Company applied for power to construct works, extend their limits, and raise more capital; but only the financial portion of the Bill was proceeded with. The South Lincolnshire and North-East Lincolnshire Water Companies were granted powers of incorporation; and the Sutton District Water Company obtained an Act to protect their sources of supply from being interfered with by well-sinking operations of the London and Brighton Railway Company. Coming to the local authorities, additional works were sanctioned for Accrington, and extensions of time for completing others were granted in respect of Bacup, Carlisle, Kettering, and the Metropolitan Water Board. The Glamorgan County Council obtained an Act authorizing them to "make "inquiries and surveys with a view to the utilization of "water supplies in South Wales," notwithstanding strong opposition by London. The New Mills Urban District Council also obtained an Act to authorize the purchase of the Ollerset Water-Works and a portion of the works and plant of the Stockport Corporation; and the Poole Corporation one to enable them to acquire the undertaking of the Poole Water Company, construct additional works, and supply water within the borough and neighbourhood. Bills were promoted to incorporate a Company for the supply of water to the parish of Heacham, in Norfolk, to enable the Croydon Corporation to extend their works, and to authorize the Great Yarmouth Water Company and the Lowestoft Water and Gas Company to construct additional works and take water from the River Bure. The first measure was withdrawn; the second was rejected by the ratepayers on a poll; the third by the House of Commons Committee after it had passed the Lords. But it is to be re-introduced.

The year's legal business has comprised some interesting cases. Early in January, the owner and occupier of a house and garden fronting on the Thames at Hampton applied for an injunction to restrain the Metropolitan Water Board from causing a nuisance by sending oil into the river from their pumping-station just above his premises, whereby, it was alleged, great injury was done to his property, and its value diminished. An arrangement was come to between the parties, after certain works had been carried out, which it was thought would effectually prevent the injury complained of. The Board defended an action brought by a builder for neglecting to supply water to him by measure for use in his business. The defence was that the complainant was not the owner or occupier of premises situated in or adjoining any street in which a main or service-pipe had been laid, and that therefore he could not demand a supply. The case was heard at the North London Police Court, and the Magistrate (Mr. Fordham) decided against the Board, who were fined 40s. and ten guineas costs. A case was stated on a point of law, and it was argued early last month before the Lord Chief Justice and Mr. Justice Ridley, who thought the decision in the Court below could not be supported; and they allowed the Board's appeal, with costs. The Board were also successful in the case of an appeal to a Divisional Court by a Mrs. Streeter against the decision of a County Court Judge nonsuiting her in a claim for compensation for damage sustained through a defective stop-cock. The appeal was dismissed with costs, and leave to further appeal was refused. But in an appeal by the Board from a decision of another County Court Judge, who had made them liable for injuries caused to a man through the defective condition of a pavement after work had been done by them, they failed to sustain their contention. An interesting case bearing upon the rights of landlord and tenant was heard by Mr. Justice Buckley. The Prudential Assurance Company leased certain premises to a Company, who leased part of them to Messrs. Salmon and Gluckstein, who sublet a portion to Messrs. Bourne. The Metropolitan Water Board levied the rate on the head lessees, who paid it, and ultimately demanded part of it from their tenants. The question was whether the latter had any right against the sub-lessees. His Lordship held—against his own opinion, but on the authority of a decision of a Divisional Court—that a water-rate was a rate coming within a covenant to pay rates and taxes, but said he hoped the matter would be taken to the Court of Appeal. Another case, bearing upon the liability of owners of premises for water-rates, was one in which the Board sued Mr. George Billings for part of the rate in respect of some houses owned by him at Wandsworth of less than £20 annual value. They were let out to weekly tenants, and it was in respect of a portion unoccupied for part of a quarter that the claim was made. It was contended for the defendant that the water had not to be paid for unless there was someone to use it; but the County Court Judge held to the contrary, and made an order for payment of the sum claimed, with costs. The Court of Appeal had before them, shortly before the Long Vacation, an appeal by the Corporation of Manchester from the judgment of Mr. Justice Farwell, dismissing their action to restrain the New Moss Colliery, Limited, from so carrying on their mining operations as to endanger the reservoirs of the Corporation. The contention of the plaintiffs was that they possessed in respect of certain land the common-law right to lateral support from adjoining land; whereas the defendants submitted that the Water-Works Clauses Act, 1847, contained a code of law, applicable to all suppliers of water, which took the place of their common-law rights, and in some respects limited them. After the case had been fully argued, their Lordships allowed the appeal. A different result attended the appeal of the Kingston-upon-Hull Corporation from the judgment of Mr. Justice Joyce, in their action to restrain the North-Eastern Railway Company from supplying, from a well at their Hessle Station, water for use in the Hull Dock. The action of the Company was said to be *ultra vires;* but the Courts thought otherwise. The Birkenhead Corporation were equally unsuccessful in their appeal from the decision of Mr. Justice Bray, at the Liverpool Assizes, just a year ago, in the action brought against them for compensation in respect of injurious affection of property, under circumstances reported in the "JOURNAL" for the 2nd of January, and again in our "Legal Intelligence" to-day.

In the Provinces, some interesting cases arose. Early in January, the Under-Sheriff of Newcastle (Mr. Broderick Thompson) sat with a Jury to assess the amount to be paid by the Tynemouth Corporation to the Executors of Lord Hastings in respect of an easement through his Lordship's land in connection with works authorized by their Water Act of 1898. The Executors claimed rather more than £1000; and the award was £500. Another claim was disposed of about this time. It was brought by Mr. A. Kellett against the Stockport Corporation to recover £12,155 for work done and materials supplied in connection with the construction of the Kinder reservoir, in Derbyshire. It was contended by the claimant that the work in question was outside his contract, and therefore was to be paid for as an extra. The case was tried by Mr. Justice Walton, who decided in favour of the Corporation. Further litigation between the parties took place last month at the Manchester Assizes, before Mr. Justice Lawrence; but the proceedings were stayed on terms arranged, subject to which the whole matter in dispute was referred to Mr. Muir Mackenzie, the Official Referee, who has lately been engaged upon it, and it stands over till the 14th prox. A claim was made by a firm at Bristol, against the Bristol Water Company, for compensation for damage to their premises through the bursting of a main; but after occupying the attention of Mr. Justice Darling and a Special Jury for three days, the verdict was that there had been no negligence on the part of the Company, and his Lordship gave judgment in their favour, with costs. It is so seldom that a Water Company is fined for refusing to supply, that the case in which the Rhymney and Aber Valleys Gas and Water Company had to pay £100 and £31 10s. costs is a noteworthy feature of the year's legal business. The whole question turned upon whether or not a certain road had been "dedicated to the public use," within the meaning of the Private Streets Act; and the Magistrates held that it had, and that the Company, by not laying down a main to supply the houses which had been put up, had set at nought the doctrine of the Act. The Company appealed to the Quarter Sessions, but the previous decision was upheld. They were, however, more successful in a case which came before the Caerphilly Police Court, in which they were summoned for not supplying the owner and occupier of premises in Upper High Street, Bargoed, with water. The

premises in question consisted of a cottage which had been converted into a small shop, for which a special rate was levied. This the plaintiff refused to pay; and his water was cut off. The Magistrates dismissed the case, but would not give the Company their costs.

Among the other legal business of the year, mention should be made of an important case which came before the Judge in the Oldham County Court, in which the Corporation sued the Lancashire and Yorkshire Railway Company for £72 4s. 1d., the balance of an account for water taken from their private service-pipes for extinguishing a fire. The defendants said they had a right to take the water; but his Honour decided that they had not. He said that if a consumer required to have on his premises protection from fire greater than that provided for him free of charge in the mains in the street, he must pay for it. Another case, which raised once more the question of what is a "domestic" supply of water, was heard by Mr. Justice Jelf, in the King's Bench Division, just before the rising of the Court for the Christmas Vacation; but, after a hearing extending over three days, his Lordship reserved his decision. A third case, turning upon the same point, was that in which the Stoke-upon-Trent claimed from the Staffordshire Potteries Water-Works Company £27 5s. they had received under an agreement for water supplied to a small-pox hospital. The Company contended that the sum did not come within the terms of the agreement, as the supply was not a domestic one. A County Court Judge held that it did. The Company appealed, and the judgment was set aside. The Tenby Corporation succeeded in getting a rule discharged for quashing a resolution to pay the engineering expenses in connection with their water scheme. A consumer of the North Cheshire Water Company declined to pay a separate amount for water used for laundry purposes, the ordinary supply being paid for by the landlord; but the Magistrates at the Altrincham Petty Sessions decided in favour of the Company. At the Barnstaple County Court, a lodging-house keeper of Morthoe was made to pay a claim of 35s. by the Ilfracombe District Council for water which he had agreed to take from them if they extended their mains to Morthoe and Woolacombe. A firm of mineral water manufacturers were ordered to pay the Tredegar Urban District Council £5 10s. 7d., with costs, for damaging a water-main with their traction-engine. The Corporation of Morpeth, as owners of Morpeth Common, recovered from the Corporation of Tynemouth £297 as compensation for injury done in laying their mains across the Common. The Basingstoke Corporation failed to sustain a claim for water supplied to a local tradesman, who refused to pay on the ground that the water was contaminated and caused the death of his nephew from typhoid fever. This was a test case, and a large number of others depended upon it. Subsequently, however, all the claims, which amounted to something like £400,000, were settled for £1675 15s.; as were those arising out of the epidemic at Lincoln last year, the total cost of which was £12,407, or an average of £4 8s. 3d. for each patient treated. An interesting case under the Income-Tax Acts arose at Llangollen; and the Council obtained a disallowance of £28 11s. 4d. on their assessment. A faulty reservoir at Castleford gave rise to litigation between the Urban District Council and the Engineers and Contractors for the work; and the Council were successful. In a case which occupied Mr. Justice Kekewich for two days, he restricted the water rights of the Neath Corporation in regard to certain ponds.

As partaking somewhat of the nature of legal proceedings, it will be convenient to refer here to the assessment questions and arbitrations which have been noticed in our columns. At the beginning of the year, the Magistrates at the West Riding Quarter Sessions had before them an appeal by the Bradford Corporation against the poor-rate assessment on the Leeming and Leeshaw compensation reservoirs and part of the Thornton Moor reservoir situated within the Keighley Union. The rateable value had been increased from £4072 to £6200, and the gross value from £5429 to £8267. The Bench decided that the old valuation must stand; but they consented to state a case on the principle of their decision. This came before the King's Bench Division of the High Court of Justice a few weeks ago, when the Lord Chief Justice said he was not satisfied that the Magistrates had applied any wrong rule of law in arriving at their conclusion, or had stated their opinions in such a way as would justify the Court in sending the matter back to them; and therefore the appeal must be dismissed. The two other learned Judges (Justices Ridley and Darling) concurred. The appeal was dismissed; but leave to further appeal was granted. Passing to arbitrations, early in the year the Devonport Corporation and the Water Company came to an agreement in respect of the price to be paid for the undertaking of the latter, which had been the subject of arbitration proceedings extending over three years. The sum fixed upon was £244,000, to include all costs payable to the Company; and the total cost of the acquisition of the undertaking was £251,160. The Earl of Carlisle claimed compensation from the Carlisle Corporation for damage done to his property by the carrying out of the Geltsdale water scheme. The amount of the claim was £33,559, including £22,888 in respect of the water-gathering properties of the estate. The matter was inquired into by Mr. John Farrer, who awarded his Lordship £17,262 as purchase-money for land and compensation for damage, and £1476 as compensation for the purchase of easements—making together £18,738. Dissatisfaction was expressed at the award, on the ground that allowance had been made in it for the water, which Lord Carlisle, it was contended, had no right to sell. On the advice of Counsel, the Corporation decided to have the matter remitted to the Umpire, with instructions to him to state a special case. The Gosport Water Company were ordered to pay £2090 for some land for which the owner claimed £4080 and they offered £847. A dispute arose between the Aspatria, Silloth, and District Joint Water Board and two District Councils as to the payment for mains in certain parishes scheduled in the Board's Act of 1901, but outside the contributory districts; the question being whether the Board or the parishes concerned should pay. A test case was submitted to the Local Government Board, who decided in favour of the Water Board. Though not partaking of the nature of an arbitration, it may not be out of place to mention here that towards the end of April a winding-up petition was presented in the case of the St. Neots Water Company, whose failure was attributed to the expense incurred in making unsuccessful applications for further parliamentary powers. The Guernsey Water Company has been reconstructed. A dispute occurred between the Torpoint District Council and the Admiralty over the costs of the Council's Bill of 1905; and eventually the Admiralty agreed to pay £5000.

Coming to the general events of the year, the long spell of dry weather in the summer claims first notice. The scarcity of water was very keenly felt at Long Eaton, Nantwich, Wombwell, and Wrexham, as well as in Essex, the Fen district, and North Wales. Reference has already been made to the steps which have been taken to improve the water supply of Coventry; and during the year schemes of various kinds have been projected or carried out with a like object in respect of Batley, Billingshurst, Croston, Devonport, Exeter, Higher Levenshulme, Londonderry, Lynn, Northampton, Ossett, Rushden and Higham Ferrers, Shanklin, Mid-Sussex, the Pickering district, and East Westmorland. Proposals to purchase water-works came under consideration at Beverley, Crewkerne, Guildford, Guiseley, Pontypool, Salisbury, and Stowmarket. The ratepayers of Newquay rejected the scheme of the District Council to acquire the undertaking of the Newquay and District Water Company, who are taking steps to improve their service. A Company obtained powers to supply certain parishes in South Lincolnshire with water, and to purchase the works of the Bourne Water Company. The Ongar Water Company is to be taken over by the Herts and Essex Company. An unusual transfer took place at Leigh-on-the-Sea, where the Urban District Council agreed to sell their water-works to the Southend Water Company. At Yarmouth, the purchase scheme of the Corporation was abandoned, in view of the present condition of the Money Market. The year has not passed without a few "scares" in regard to water supply. Perhaps the most important one was that which occurred in Edinburgh, where the water was reported to contain fleas. But three experts who were called in thought the insects might be beneficial rather than otherwise, as they acted as "scavengers." It was decided to accelerate the replacement of the existing ball hydrants by those having valves. There was a slight outbreak of enteric fever among the officers in the camp at Fleetwood; but it did not arise from the impure condition of the general water supply. At Pontypool, however, the epidemic was more serious; and it was resolved to ask the Gas and Water Company to disinfect the whole of the mains. At

Pontypridd, the water was suspected of causing lead poisoning; and the Medical Officer of Health expressed his dissatisfaction with it in several respects. As bearing upon the supply of pure water to the consumers, it may be mentioned here that the Joint Committee on Water Regulations have done good work during the year in preparing for publication a model code, with schedules setting out specifications of water-fittings; and that the Public Health Committee of the London County Council have lately presented a valuable report on water supply to tenement houses in their area of control.

With regard to the technical matters connected with water supply which have engaged attention during the year, the two gatherings of the Association of Water Engineers deserve first attention. At the summer meeting, which was held at Scarborough, where the President (Mr. W. Millhouse, Assoc.M.Inst.C.E.) is the Water Engineer, an interesting Inaugural Address, three useful papers, and some instructive visits rewarded those who attended it. A pleasant feature of the proceedings was a presentation by the members to Mr. and Mrs. Millhouse, on the occasion of their silver wedding. At the winter meeting, held early this month in London, the chief feature of the programme was Dr. Kemna's valuable communication on the use of copper sulphate for the filtration of water—the successful trial of which at Newport (Mon.) was recorded in the first number of the "JOURNAL" for the year. The paper gave rise to a long discussion, in which very guarded opinions were expressed as to the advisability of adopting the author's process. The Association discussed the subject of water-works bye-laws and regulations; and other matters brought before the members are noticed in the present issue. At early meetings this session of the Institution of Civil Engineers, three papers on water supply have been under discussion. At the annual congress of the Royal Sanitary Institute, Dr. Rideal read a paper on the "Prevention of "the Growth of Algæ in Water," prepared by him in collaboration with Mr. Orchard; while Dr. E. F. Willoughby dealt with "Rural Water Supplies." Before the Junior Institution of Engineers, the new President (Mr. W. B. Bryan, M.Inst.C.E., the Chief Engineer of the Metropolitan Water Board) delivered an address on "Water Supply," mainly from an historical point of view. At the Society of Engineers, Dr. Sommerville read a paper on "The "Chemistry and Bacteriology of Potable Waters;" and before the Association of Engineers-in-Charge, Mr. H. C. H. Shenton discoursed on "Small Water Supplies." The subject of electrolysis was brought before the Association of Water Engineers by Mr. Baldwin Latham at their meeting this time last year, and was noticed in our columns shortly afterwards. It was also reported upon by the Electrolysis Commission of the German Association of Gas and Water Engineers in the summer. The question of the afforestation of watershed areas came before the Bradford Town Council, who instructed the Water Committee to obtain expert advice upon it. The Edinburgh and District Water Trustees also had it under consideration in connection with planting about 5000 acres of the Talla watershed area. The long-expected report on the result of Professor Wertheimer's investigations into merits of the "dowser" appeared towards the end of September; but its conclusions were not very definite. Some successful experiments were reported from Wakefield in the summer. Of the engineering works in progress, those constituting the Derwent Valley scheme are the most important. Unfortunately, a slight check occurred in the summer, owing to the discovery of a fault at the Howden dam. Otherwise, constructional work generally seems to have gone on steadily, and some rather interesting examples have been recorded. A few accidents have to be noticed. Owing to heavy floods in March, the Antwerp Water-Works were damaged; and from the same cause, the new ones at Breslau were for a time rendered incapable of yielding water fit for use. A reservoir burst at Houghton-le-Spring; and a few bursts of mains have occurred—among them being a 12-inch pipe of the Liverpool Corporation, between Oswestry and Malpas, and a 36-inch one in Hyde Road, Manchester.

Before closing this retrospect, a few personal matters call for notice. Mr. Edward Bush retired from the position of Chairman of the Bristol Water Company. Mr. A. Cox, a member of the Falmouth Town Council, was appointed Manager of the local Water Company, in succession to his father, the late Mr. J. G. Cox. Mr. T. Hewson, jun., the Deputy City Engineer of Leeds, severed his connection with the Corporation after 22 years' service. A testimonial was presented to Mr. C. H. Priestley, the Water Engineer of the Cardiff Corporation, on the completion of his 25th year of service. During the twelve months now closing, the ranks of officials and others connected with water undertakings have been thinned by the following deaths: Mr. G. Anderson, the Secretary of the Thirsk District Water Company; Herr Eduard Beer, the Manager of the Berlin Water-Works; Mr. C. Brierley, the first Chairman of the Bury and District Joint Water Board; Mr. W. Dickinson, the Chairman of the Falmouth Water Company; Mr. A. Duncanson, at one time Borough and Water Engineer of Liverpool; Mr. J. C. Gittins, the Deputy-Chairman of the Brymbo Water Company; Herr Ernst Grahn, of Hanover; Sir John Harwood, of Manchester, who was associated with the Thirlmere scheme from the commencement; Mr. C. S. Kirby, the Manager of the Bridlington Water-Works; Dr. E. H. Perowne, the Chairman of the Cambridge University and Town Water-Works Company; Mr. C. E. De Rance, who was an authority on underground waters; Mr. F. Russell, the Engineer and Manager of the Bexhill Water and Gas Company; Mr. J. A. Wanklyn, the well-known water analyst; and Alderman William Watkins, J.P., the Chairman of the Cray Water Committee of the Swansea Corporation.

"Gas Progress."

In the "JOURNAL" for Sept. 18 last, we criticized the first issue of the "Electrical Bulletin," published by the combined subscription of the London Electric Lighting Companies. The scurrilous and deceptive character of the contents of this "Bulletin" was pointed out; and the article concluded with these sentences: "Without dipping farther into the 'Bulletin,' enough has been said to show that it has been prepared especially to decry gas in all directions without those responsible for its production being over-scrupulous on the point of fairness. *The London Gas Companies might do worse than respond with 'A Review of the Electrical Bulletin.'* Perhaps, however, they will consider that, if the first number is a fair sample of what is to follow, it will defeat its own object among intelligent men." The suggestion made as long ago as three months since fell on rocky ground, so far as the London Gas Companies were concerned. There was a variety of opinions on the subject—one being that it was not believed that honourable Directors of Electric Light Companies would continue to countenance the misrepresentation contained in the first number of the "Electrical Bulletin;" another was that the matter contained in the publication was so obviously one-sided that all householders of average intelligence would treat it in the same manner that they would the over-flavoured literary productions of medicine quacks; another was that simple announcements, with pointed truths, would obtain more attention, and produce more effect, than a magazine packed with information however truthful, and that the Gas Companies were well supplied with literature of the kind of their own; and yet another was that these fulminations of the electrical people could be more effectively dealt with by demonstration than by literature. On all these points, other opinion may be held; and Messrs. John Allan and Co. are among those who entertain views contrary to those expressed above. They have taken up the idea of a literary counterblast, and are bringing out a little quarterly magazine under the title of "Gas Progress." The object of the new periodical is defined in the first paragraph. "There is no lack," it is said, "of technical literature for those who are engaged in the manufacture and supply of gas; but so far there has been no periodical published in the interests of the consumers of gas." Of course, it is known quite well what is intended by the latter part of this statement; but it must be claimed that the technical gas literature published weekly has been, and is, very largely "in the interests of the consumers of gas." But the form in which such literature is presented is not that required by non-technical gas consumers. And so "the object of 'Gas Progress' is to fill the gap—to give guidance to the consumers in regard to the manifold uses of gas, and the methods by which efficiency and economy may be attained in such uses." Some of the illustrations in the new magazine are old friends, though perhaps not to the consumer. The matter is written in suitable style, and will readily be understood by those whose knowledge of gas and its uses is of the most rudimentary. The magazine is well printed on good paper; so that altogether those who believe in this form of advertising will find their requirements adequately met. We might support an indirect suggestion of an electrical contemporary, that the picture on the cover of the magazine should be altered, as it is not customary for a gas-cooker to stand, much less to be used, at the entrance to a drawing-room. The artist has drawn a little too much on his imagination—probably for the purpose of bringing within one picture a cooker, a gas-fire, and a pendant bearing inverted gas-burners.

INCANDESCENT MANTLES MADE FROM ARTIFICIAL SILK.

The New Cerofirm Mantle.

By Dr. C. Richard Böhm, of Berlin.

The textile basis of the incandescent mantle originally consisted of cotton yarn of fine quality. In recent years, however, the cotton has been largely replaced by ramie—a material which is far superior for the purpose. Whereas a mantle derived from cotton, after being a short time in the flame, gradually lost its shape, and on that account diminished in illuminating power, the ramie mantle preserves its shape much longer, and the diminution in candle power after a long period of burning is hardly noticeable. The great drawback to the incandescent mantle, however—its tendency to break—still remained; and the efforts which have been made in recent years have been mainly directed towards improving the stability of it.

Attempts have been made to employ other vegetable fibres—such as silk, hemp, and jute—as the oxide-bearer, with, however, negative results. In the latest researches, the vegetable fibres have been replaced by artificial threads; and the addition of the Welsbach salts is made during the preparation of the artificial silk itself.

It is now common knowledge that Chardounet succeeded in preparing threads and cloth, which had previously only been produced from organized fibres of vegetable and animal origin. He employed cellulose in the form of a solution of collodion or gun cotton. This artificial or cellulose silk is made by the following process: The nitro-cellulose, prepared by the action of a mixture of sulphuric and nitric acids on cotton wool, is dissolved in a mixture of alcohol and ether in equal proportions, until a thick fluid is formed. The solution is filtered; and from a tinned steel vessel it is pressed out through fine glass tubes of 0·08 mm. diameter under a pressure of 50 atmospheres. The threads congeal immediately on coming into the air. No treatment with water is necessary; since the volatile vapours are taken away by means of suction plant. Several of the fibres are immediately spun to obtain a thicker thread; and the material is denitrated by means of ammonium sulphide. The explosive properties are thus removed, and a substance consisting essentially of cellulose again remains.

I say "essentially," because the cellulose by this process is altered chemically, and its characteristic properties are changed. By the application of an ammoniacal solution of cupric oxide (Schweitzer's reagent), solutions of cellulose have been obtained, which have been put to certain technical uses. This application is limited, because for most purposes either the solvent is too costly or the presence of copper in the solution is inadmissible. By the action of an ammoniacal cupric oxide solution, the copper compound of cellulose is formed; and after drying the substance, the copper can be removed by acetic acid.

Cross, Bevan, and Beadle have also found a new process by means of which the cellulose is dissolved and reprecipitated without any essential chemical alteration. This process is cheap, and yields a product which can be put to a variety of uses.

The starting material of the new process is the well-known substance produced by the action of caustic alkalies on cellulose. A bulky, transparent mass is formed by the assimilation of alkali and water. It is familiar in the process of mercerization. This substance is then further changed by the action of carbon disulphide—swelling up still more until it becomes completely gelatinized, and is then soluble in water. The aqueous solution has a yellow colour, and is very viscous. From this solution the cellulose can be separated with its original properties. While the dissolved cellulose in this process is called "viscose," the separated product is known as "viscoid."

The artificial threads produced by the three methods above described are distinguished from fibres of natural origin, in that they are not tubular but solid throughout; and the cellulose is presented in the hydrated gelatinous form instead of in the form free from water. This fact is of great importance in the subsequent operations of preparing the incandescent mantle. The dissolved cellulose has a plastic form, and readily adapts itself to the treatment adopted.

At one time—when the Auer patent monopoly did not permit the manufacture of mantles on the part of competitors—a patent was taken out by Knöfler in 1894 (German patent No. 88,556) for a process in which suitable proportions of the salts of the rare earths dissolved in alcohol were added to the collodion solution. The threads pressed out through capillary tubes were either dried in hot air or pressed under water.

The burning off of such threads, or the tissue woven from them, takes place very violently, on account of the unchanged nitrocellulose. On this account, it is necessary to denitrate the tissue by means of ammonium sulphide. By this treatment, the explosible nitro group is removed, and the rare earths are converted into hydrates.

While Knöfler made use of the salts of the rare earths containing water of crystallization, Plaissetty took as a binding material the anhydrous salts (German patent No. 129,013) with the addition of the least trace of collodion. The product which is obtained by this process, after drying, is said to burn off slowly, and can be used without any previous denitration. In order to make the tissue more flexible, it is treated with ammonia, whereby the hydrates are formed. In this way, Plaissetty arrived at the same product as Knöfler.

According to an English patent (No. 26,381, of 1897) of Blasco de Léry, the salts are dissolved in acetic acid, and, after the addition of glacial acetic acid, mixed with a solution of collodion wool in glacial acetic acid. By mixing together 10 parts of collodion wool, 3 to 5 parts of salts, and 120 parts of acetic acid, a mass is obtained which can be spun. The mantle made from the spun threads weighs, before burning off, about 5 grammes, and yields 0·6 gramme of ash. By Plaissetty's process as mentioned above (German patent No. 129,013), a material which can be spun is obtained by the mixture of 9 parts of collodion wool, 15 parts of salts, and 31 parts of solvent. The mantle knitted from such threads also yields 0·6 gramme of ash; but, on the other hand, it only weighs 1·5 to 1·6 gramme. So that it is considerably lighter in weight than that produced by the English process.

Plaissetty maintains that all these methods are associated with great drawbacks, since the viscose from which the artificial threads are obtained can only take a limited amount of the earths, and the resulting threads are difficult to spin.

In 1893, Schlumberger and Tinibaldi, in a Belgian patent (No. 106,592), indicated the possibility of impregnating threads of artificial silk with the thorium salts. Plaissetty, too, has shown that these artificial threads—in spite of the fact that they lack the hollow interior of the natural fibres—can nevertheless be impregnated with the salts to produce a serviceable mantle. According to the process patented in 1902 (German patent No. 141,244), the artificial silk is dipped into the solution of salts; and, on account of its colloidal nature, practically any amount of nitrate can be absorbed. In this respect, artificial silk differs from cotton, which will only absorb a limited quantity.

In the new mantles, a direct combination takes place between the cellulose and the salts, which is supported by experiments with the microscope. The silk, after being impregnated with the nitrates of the earths, is carefully dried, and then immersed in a concentrated solution of ammonia. The nitrates are thereby converted into hydrates, which enter into intimate combination with the gelatinous cellulose. Although the thread contains about 40 per cent. of its own weight of nitrate, it does not appear changed in any way. It possesses the same bright appearance, and has about the same bulk as before.

This process has now been worked out sufficiently to allow of its being exploited commercially. The French patent was acquired by the French Auer Company, while the German patent was bought by the Cerofirm Gesellschaft (formerly Bruno and Lietz), of Berlin.

By literally following the Plaissetty process for producing incandescent mantles from collodion silk, a good result is obtained, but showing no particular advantages over the ramie mantle. In the first place, the stability of such mantles leaves much to be desired. Now this is the most sensitive spot of the incandescent gaslight industry; and for a long time experimenters have endeavoured to produce a mantle which will not break. Until recently, none of the many investigations directed towards this object has been successful. It is true that the stability of the mantle can be increased to a certain degree, by impregnating it in the solution to a greater extent; but the increase in stability is so small that it has practically no value. The illuminating power of such mantles is moreover considerably smaller than that of the ordinary mantles. It has also been attempted to produce incandescent mantles from fine wires, or incombustible threads—such as asbestos. This, too, seems to be the nearest way of approaching the problem of the stable mantle. But the results have always been negative; and it is only to be expected, because the mantle, on account of its greater bulk and weight, absorbs too much heat from the flame, and on that account emits relatively less light.

Plaissetty, however, was on the right way of solving the problem of the stable incandescent mantle. The well-known experimenter, Bruno, acknowledged that thorium hydrate possesses so many excellent properties that for the manufacture of incandescent mantles it is far superior to thorium nitrate. Thorium nitrate is known to possess a property by virtue of which, on heating, it blows out and expands considerably. This behaviour of thorium nitrate is used as a test, since it is supposed that a sample which exhibits a propensity to expand yields an incandescent mantle which does not conglobate (wrinkle). The conglobation or wrinkling is a phenomenon which shows itself in the early stages of the burning of the mantle, and is undesirable, since it is also associated with a rapid decrease of illuminating power.

The thoria derived from thorium nitrate forms a loose powder, which can be rubbed down on the surface of the palm something like meal. On the other hand, the thoria derived from thorium hydrate by heating to incandescence does not display this phenomenon of expansion, but conglobates immediately—yielding, instead of a loose powder, sharp oxide crystals of diamantine hardness.

These apparently defective properties of thorium oxide derived

from the hydrate appeared to make it entirely unsuitable for the manufacture of incandescent mantles. But even if the mantles produced from collodion silk by Plaissetty's process show no particular superior advantages, nevertheless these relations are altogether changed when we pass over to another artificial silk. As already described, cellulose with unchanged properties can only be separated from an ammoniacal cupric oxide solution. If now the cupric oxide cellulose fabric is treated according to Plaissetty's process, a mantle is obtained possessing quite unexpectedly valuable properties.

The former unburnt mantles had the undesirable property of withdrawing moisture from the air with great avidity. Since almost all gas-works and many large contractors take their mantles not in the burnt-off, transportable state, but as half manufactured—*i.e.*, unburnt-off—so this hygroscopic property of the mantle is a source of unceasing trouble. The mantles becoming moist contract when subsequently burnt off, and easily become irregular and crooked. The new mantle—from copper cellulose by the Plaissetty process—is, however, not hygroscopic; since the thorium hydrate, unlike thorium nitrate, does not absorb the least trace of humidity. It will, therefore, be seen that this property may be an exceedingly valuable one.

For the testing of mantles with a view to stability, mechanical vibratory machines have been constructed, which transmit vibrations in both the vertical and the horizontal directions. On a Drehschmidt machine (fig. 1), adapted for intense vibrations, some comparative experiments have been performed. An ordinary mantle of good quality withstood 90 to 100 vibrations. The

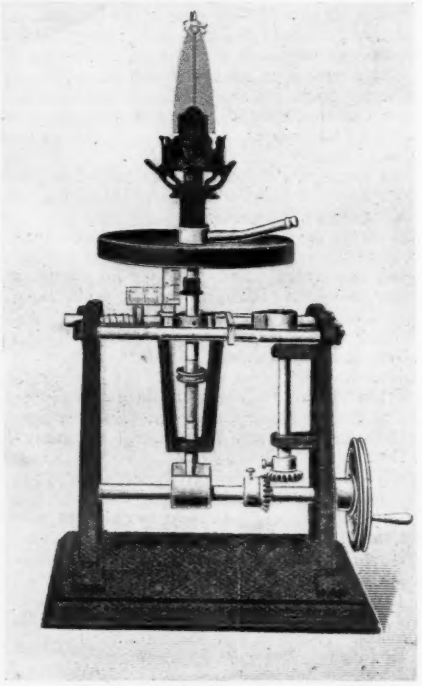


Fig. 1.

new mantle, however, remained perfectly intact after 3000 vibrations. There can be no doubt, therefore, that this mantle is far more stable than the ordinary one. The mantle was exhibited by Bruno in a lecture delivered at Nuremberg in June this year. The mantle can be taken in the hand, after burning off the protective film of collodion, and put to various tests. It may, for instance, be rolled on a pencil without breaking. It not only possesses greater tensile strength than an ordinary mantle, but is also much more elastic. These excellent features denote the great advance which has been made by means of this discovery.

The accompanying illustrations serve to demonstrate the microscopic structure of the old and new mantles. Fig. 2 shows a loosely interwoven thread of a ramie mantle, consisting of a countless number of entangled fibres. Fig. 3 shows a similar portion of an artificial silk mantle. It will be observed that the threads are not entangled as in the ramie mantle, but stand out distinctly, more like wires. The quantity of individual fibres is also much less in the case of the new mantle. The illustration serves to distinguish clearly the great structural difference between the vegetable fibre and the artificial fibre.

On account of the great importance of the new invention, it was supposed that the competitors would test the validity of the patent. The proprietors of the German patent, the Cerofirm Gesellschaft, therefore, conducted very careful investigations before coming before the public with their new mantle.

The patent claim of Plaissetty's ammonia process runs as follows: "Process for the preparation of threads for incandescent mantles consisting in impregnating artificial threads of all kinds, or tissue from such threads, and after drying leading through an alkaline bath and then drying again."

Since the alkaline bath is the most important feature, investigations were made to see if the formation of hydrate could not be brought about by means of other reagents. Now this question was easy to answer for a specialist in the rare earths, since an analytical process is known by which the thoria is precipitated by means of hydrogen peroxide. The use of hydrogen peroxide in the manufacture of mantles was also not new, having been proposed by Drossbach as far back as 1899 (German patent No. 117,745). Drossbach found that the higher oxidized salts of thorium—especially the nitrate—after the usual addition of ceria, were especially suitable for the manufacture of incandescent mantles. After bringing the same to incandescence, the thoria remains behind in a peculiar molecular condition, the illuminating power of which—the same consumption of gas and other things being equal—is far higher than that of the ordinary mantle. For instance, the photometrical determination gave 143 Hefner candles as against 80 Hefner candles with a mantle from normal thoria and ceria.

The peculiar character of the higher oxide of thorium consists in the greatest illuminating power being evolved with an addition of 1·6 per cent. of ceria, and in the fact that the light emitted is snow-white. On the other hand, a normal mantle with an addition of only 1 per cent. of ceria gives out a yellowish green light; while with 1·6 per cent. of ceria a dull reddish yellow light is emitted. Also, under the microscope, the mantle prepared according to Drossbach's process appears considerably altered.

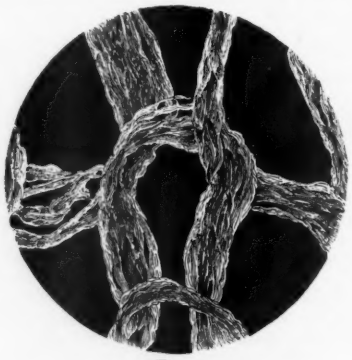


Fig. 2.

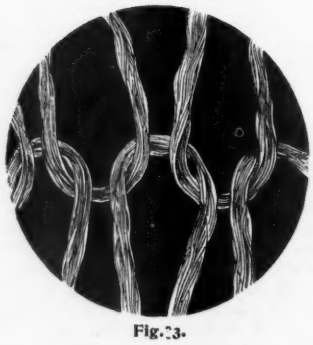


Fig. 3.

The fabric of an ordinary thoria-ceria mantle under the microscope seems quite uninjured, and only in a few places is the yarn rolled open, due to the expansion of the thorium nitrate, as previously mentioned. By the use of the higher oxidized nitrates, the thread is resolved into its individual fibres, by virtue of which the exterior surface is enlarged and the illuminating power increased. The Drossbach process for the production of incandescent mantles differs from the old process in that—in place of the salts of thorium previously used—the higher oxidized compounds are employed. The impregnation, drying, and burning off operations are carried out in the usual way. The patent claim states as follows: "Process for the production of incandescent mantles consisting in employing the higher oxidized salts of thorium, obtained by the oxidation of thorium solutions, in place of the previous employed normal salts."

Since hydrogen peroxide solutions react slightly acidic, it was easily possible to evade the Plaissetty patent by substituting hydrogen peroxide for the alkaline bath. As also the researches in this connection had proved that the mantles produced by means of hydrogen peroxide were superior to those produced by the use of ammonia, a patent was applied for; and then, for the first time, the new mantle was made public.

The application for the patent was filed on March 6 last, in the name of Albrecht, and was open for inspection on July 23. Unlike the invention of Drossbach, by treating the impregnated mantles with hydrogen peroxide, a thorium hydrate is obtained which does not expand but coheres; and owing to this property great stability is conferred on the mantle. The patent claim states: "Process for the production of incandescent mantles by

the use of hydrogen peroxide, consisting in treating the thorium salts of the impregnated unburnt-off mantle with hydrogen peroxide."

Since hydrogen peroxide only converts the thoria into an insoluble form, sufficient cerium nitrate is added to the solution to produce the desired proportion of ceria which the mantle shall contain. This is readily controlled by empirical means.

The mantle prepared by the modified Plaissetty hydrogen-peroxide method does not, according to Bruno, contain the thorium as the ordinary oxide (ThO_2), but as a higher oxide for which the formula Th_2O_7 has been assumed. Judging from previous scientific investigations, thorium peroxide does not resist heat; but, nevertheless, Bruno attributes the remarkable physical properties of the mantles produced by the modified Plaissetty hydrogen peroxide process to a higher oxide of thorium, since the new mantles often emit a light of 130 to 140 Hefner candles. The average is 120 to 130 candles with the ordinary gas pressure and consumption.

But I have already shown that the mantles made by Drossbach's method also emit a light of 140 candles. Drossbach has attributed this phenomenon to the enlargement of the exterior surface, while Bruno inculcates that with his process a thorium hydrate is produced which does not expand or blow out at all. The principal feature attained by Bruno's patent seems to me not to consist in its high light power, but in the remarkable stability of the mantle. It is true that the patent specification lays more stress on the great emission of light produced by the new mantle. But it seems to me the relations are reversed, and that the hitherto unattained stability exhibited by the new mantle is its most striking feature. Latterly Bruno appears to have altered his view; and he now considers the stability and elasticity of the new mantle to be its most valuable characteristics.

Up to the present, it has only been possible to manufacture incandescent mantles from artificial silk by the aid of special apparatus and methods. In particular, it has not been possible after the impregnation of these mantles to convert them into ash, mould, and harden them by the use of the blow-pipe. When collodion mantles are turned into ash, as soon as the salts in the heat of incandescence are converted into oxides, the artificial threads do not retain their uniformly extended form, as do the natural ones from ramie and cotton. They curl up together, so that subsequent treatment with intensified gas for moulding and hardening is impossible.

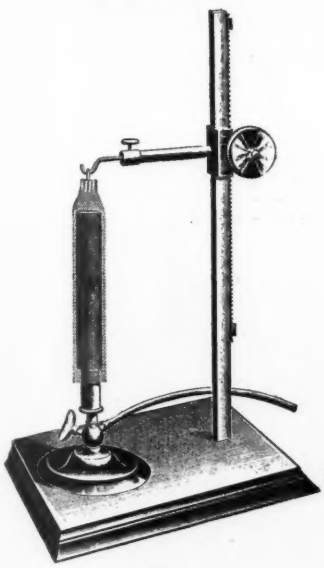


Fig. 4.

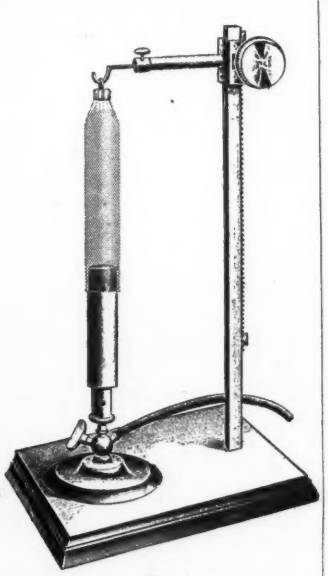


Fig. 5.

To overcome this curling, the mantles are ashed, moulded, and hardened in one operation. The mantle is supported over a burner-tube corresponding to its width, so that only the top of the mantle projects above the head of the burner, as shown in fig. 4. The intensified gas is now allowed to enter, and is ignited. The mantle is then raised slowly through the flame—about 1-50th of an inch at a time. Having once been drawn through the flame, the burning off is complete—fig. 5. The pressure of the intensified gas should in no case be higher than about 8 inches, which is much less than that used in the manufacture of ramie and cotton mantles. When the flame roars, it is quite sufficient, as too high a pressure is injurious. The mantle after burning off should not be hard, like a ramie or cotton mantle, since it is really toughest, or, better expressed, more elastic, when in the soft state. It is better that the mantle should be somewhat pointed, as shown in fig. 6, and not full like the ordinary variety—fig. 7. It has been found that the pointed form not only gives the best illuminating effect and the most economy, but also lasts the longest.

The process for burning off the mantle has also been patented in the name of Albrecht (for the Cerofirm Gesellschaft), on March 6 last, and was declared open for inspection by the German Patent Office on July 23.

There can be little doubt that this last great step forward has been due to the united efforts of Plaissetty and Bruno. Like most inventions of great general importance, the new process is the result of the labours of many patient workers. It must not be supposed that the idea of an invention is always the most important point. On the contrary, the working out of the same generally presents the greatest difficulty; and for this reason it should not be esteemed less highly. So it is in this case. It was

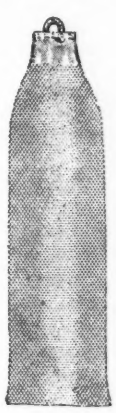


Fig. 6.

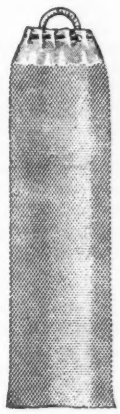


Fig. 7.

known that artificial silk might be impregnated with the salts of the rare earths; it was known that the threads of cupro-cellulose were suitable for this purpose; and the action of hydrogen peroxide on the rare earths was also well known. All these, however, did not suffice to produce a mantle superior in stability or elasticity to previous ones. A very important factor was still missing, and that was the right comprehension with which the various inventions must be considered before any real practical success could be attained.

Finally, it is well to point out that in the new mantle some secret process seems to be involved. By literally following the process set out in the patent specifications, negative results only are obtained. When the ramie mantle was first introduced, it was a long time before the proper treatment and working up of this fibre was thoroughly understood. Not till then did ramie yield an incandescent mantle far surpassing in its qualities the older cotton mantle. It may safely be assumed, therefore, that the same relations hold in the case of artificial silk. Cupro-cellulose has its peculiarities; and these must be understood before the many difficulties can be overcome. The Vereinigten Glauzstoff-Fabriken, of Elberfeld, are delivering the woven fabric to the Cerofirm Gesellschaft, and are also participating in the venture. There is thus every reason to suppose that competitors will have great difficulty in obtaining supplies of the necessary raw material. The first-named Company have been manufacturing artificial silk for some time, and are reported to be making huge profits, like most of the other Continental concerns manufacturing artificial silk. Bruno probably regards his business relations with the Vereinigten Glauzstoff-Fabriken quite as important as the purchase of the Plaissetty patent.

The incandescent gaslight industry may, I consider, heartily congratulate itself. It has scored another immense success—being now capable of producing a mantle in which the one great drawback of fragility is for ever set aside.

An Automatic Water-Finder.—Herr Adolf Schmid, of Berne, has invented an automatic water-finder, which, if all that is claimed for it is justified, will drive the professional "dowser" out of the field. Herr Schmid says his apparatus will "tell the attentive searcher for water, in a relatively short time, whether at certain points of the earth there is subterraneous water flowing at a conveniently attainable depth." In appearance the apparatus resembles the magnetic needle and box of the ordinary electric telegraph; and it is the needle which, by its oscillations, electrically divines the existence of an underground spring.

Action of Water on Lead Pipes.—The occurrence of numerous cases of lead poisoning caused by water taken from the Dessau mains led to a systematic study being made of the effect of the composition of the water on the material of the pipes. The results of the researches, which were very long and minute, were given in a recent number of the "Zeitschrift für Elektrochemie." They show that aërated distilled water will dissolve 140 milligrammes of lead per litre under exceptional conditions; but the ordinary maximum is 110 to 115 milligrammes. In any case, the solvent action takes place rapidly. The conclusions arrived at were: (1) Solubility of lead depends upon the quantity of oxygen in the water and also upon the carbonates; and as these bodies exist in all water, they should be reckoned in every case. (2) Presence of free carbonic gas favours solution. (3) Hydrocarbonates decrease solubility. (4) Sulphates and perhaps other salts, like chlorides, increase solubility.

THE LATE MR. F. L. RAMSDEN.

In the last number of the "Journal," we recorded the death, the previous Sunday evening, of Mr. F. L. Ramsden, the Engineer and Manager of the Burton-upon-Trent Gas-Works, and briefly noticed his career. We are now in a position to give some few additional particulars.

Mr. Ramsden was born at Huddersfield on Nov. 17, 1852, and commenced his career in the chemical works of Messrs. Read Holliday and Sons, Limited. He afterwards went into the works of Messrs. W. C. Holmes and Co., where he remained till about 1871, when he entered the service of the Sheffield United Gas Company. His keen business habits soon led to his promotion; and he eventually filled the position of Assistant at the Effingham Street works. In 1885, he obtained the appointment at Burton, in succession (as previously mentioned) to Mr. John Mudie, who, strangely enough, succumbed to the very disease from which Mr. Ramsden was so long a sufferer. At that time, the sales of gas amounted to about 176 million cubic feet per annum; whereas last year they had reached 319 millions. Reference was made last week to the scheme of reconstruction which he prepared, and under his management practically every department of the works was extended. His improvements were not confined to the manufacturing plant. During recent years, the public lighting has been changed from the flat-flame to the incandescent system, and the modern auxiliaries to gas consumption, the prepayment meter and the cooking-stove on hire, have been introduced. Under his *régime*, the gas-works were made the most lucrative of the profit-producing departments of the Corporation. When electric lighting was adopted in 1891, Mr. Ramsden was entrusted with the management of the plant; but in 1903 he relinquished it, and it was taken over by Mr. Pringle, who was Manager of the then newly constructed tramways. Mr. Ramsden was a conscientious and hard-working official, and was much looked up to by the members of the Corporation, more especially those who constituted the Gas and Electricity Committee. Mr. Ramsden was a prominent Freemason, being P.M. of the Abbey Lodge and member of other Lodges; but he took little part in public life. He leaves a widow, one son, and two daughters to mourn his loss.

The funeral took place at the Cemetery last Tuesday, amid many tokens of sympathy and respect. The chief mourners were Mr. R. S. Ramsden, Mr. W. L. Ramsden (Manager to Messrs. E. Cockey and Sons, Limited, of Frome, and brother of deceased), and Mr. J. Husband (son-in-law). The coffin was borne by eight of the employees at the gas-works from the gates to the chapel. The members of the Gas and Electricity Committee joined the procession, and there was a large following of Corporation officials, as well as representatives of the Abbey Lodge. Among the personal and professional friends of the deceased was Mr. G. B. Smedley, the Manager of the Swadlincote Gas-Works; but Mr. J. Ferguson Bell, of Derby, was unable to carry out his intention to be present. The service was conducted by the Rev. H. B. Freeman, the Vicar of Burton, who, in the course of a brief address at the grave, said they were gathered round the last resting-place of one who had left behind him a lesson of courage and patience such as was hardly ever known. They might well take home with them the wonderful lesson that patient sufferer had taught them.

PERSONAL.

Mr. William J. Geary, who has for the last six years been General Foreman at the Conway Gas-Works, has been appointed Working Manager of the Stony Stratford Gas and Coke Company, Limited. There were 41 applicant for the post.

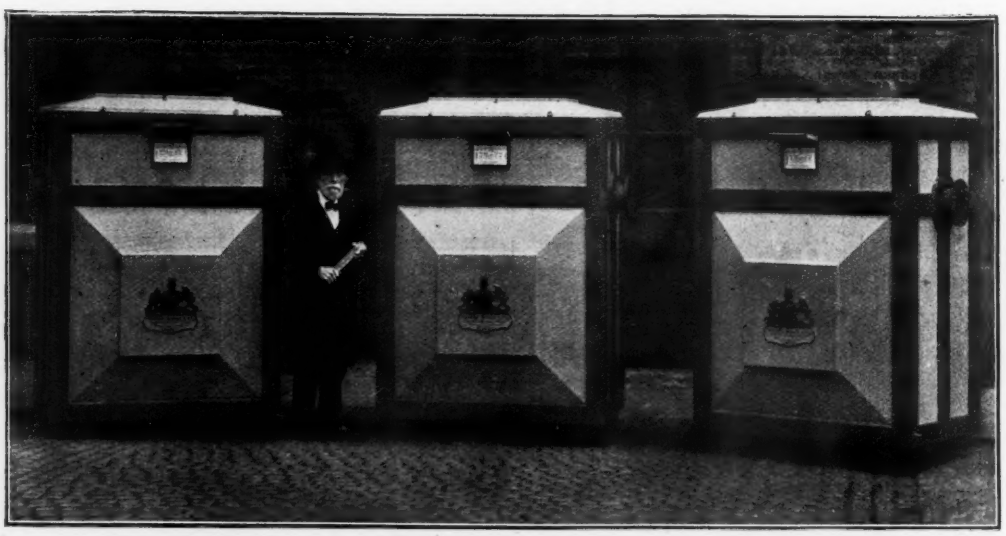
Mr. Charles H. Carder, Chemist and Assistant at the Tipton Gas-Works, has obtained the appointment of Chemist at the Grangetown works of the Cardiff Gaslight and Coke Company. He will take up his new duties on the 1st prox. Mr. Carder served his articles under Mr. S. O. Stephenson at Tipton.

Pending the appointment of a successor to the late Mr. F. L. Ramsden as Engineer and Manager of the Burton-upon-Trent Gas-Works, his son, Mr. R. S. Ramsden, who, as mentioned in the obituary notice which appeared last week, had been associated with him, has been instructed by the Chairman of the Gas and Electricity Committee (Mr. Alderman Lowe, J.P.), to act generally in his father's place.

It will be matter of regret to his many friends to learn that Mr. W. M'Crae has, on account of the state of his health, been obliged to resign his position as Manager of the Falkirk Corporation Gas-Works. Last April, it will be remembered, Mr. M'Crae was granted leave, and went to Harrogate to recuperate—being, in fact, unable to take part in the opening ceremony in connection with the gas-works of the Corporation, which were erected under his supervision. Mr. M'Crae was President of the Informal Meeting of Gas Managers last spring; and he is at the present time one of the Vice-Presidents of the North British Association of Gas Managers.

The death is announced of Mr. Thomas Henry Cheatle, who was Chairman of the Burford Gas Company, as well as a Director of the Water Company. Deceased was the last surviving member of the now defunct Burford Corporation.

METERS FOR THE GAS-ENGINES AT THE FALCON BROOK PUMPING-STATION.



The accompanying illustration is taken from a photograph of three 600-light dry gas-meters which have just been completed to the order of the London County Council by Messrs. George Glover and Co., Limited, of Chelsea; and it is interesting to note the increasing use of large dry meters with gas-engines for various public works—such as drainage, &c.

We learn from the "Contract Journal" that the London County Council have for some time been busy on an improved drainage scheme in Battersea; and a new pumping-station (the Falcon Brook Pumping-Station) has been erected to raise and discharge the storm water into the river at Battersea. This station will receive the storm water from three separate sewers—viz., the low-level sewer in York Road, the Falcon Brook sewer, and the new relief sewer. The raising and discharge of the water into Battersea Creek will be carried out by three 27-inch centrifugal pumps (Mather and Platt's make), each capable of discharging 13,333 gallons per minute to a height of 16 ft. 6 in. These will be driven by three gas-engines with three inverted cylinders, 17 inches in diameter by 20-inch stroke—175 B.H.P.—made by the Campbell Gas-Engine Company.

THE ASSOCIATION OF WATER ENGINEERS.

WINTER MEETING, DEC. 8, 1906.

PAPERS READ.

(3)

THE WIND-ENGINE FOR PUMPING.

Mr. George Phelps (Manchester) read a paper on the above subject. He opened it with a few historical particulars, and then pointed out that there are two principal types of modern wind-engines—those having fixed and movable hinged sails respectively. Having briefly described these, he offered a few remarks on balancing, loading, the selection of a site, and the attendance required for a wind-engine; and he passed on to deal with its suitability for pumping. This portion of the paper was as follows.

Suitability for Pumping.

The wind-engine may be used for a great variety of purposes; but there is no other to which it is so well adapted as to the pumping of water supplies. The reason for this will be quite obvious when it is considered that it depends for its power entirely on so uncertain an element as the wind, and that efficiency can only be obtained by taking advantage of all the wind that is available, and storing the resultant work. In the case of pumping, this can be done by providing sufficient storage for the water, and leaving the engine free to work at all times. With any other class of work, these conditions are not so easily fulfilled. The only thing necessary to ensure a constant supply of water—provided that the yield of the well is ample—is that the reservoir shall hold sufficient water to tide over the longest period during which the engine may be stopped in calm weather. With regard to the size of reservoir required, it is advisable (except under certain conditions to be hereafter mentioned) to provide storage capacity equal to 14 days' supply, which experience in this country shows to be quite sufficient where a suitable site for the wind-engine is available. This being so, it might at first sight appear that the cost of the reservoir would, in many cases, practically prohibit the use of a wind-engine; but, though the initial outlay is often large, the working expenses of a good wind-engine scheme are so small that highly economical results are obtained. About £5 or £6 per annum is generally sufficient to cover the whole cost of oil and attendance in connection with a village supply.

In the case of villages or towns applying for a loan for the purpose of carrying out a water supply, where a wind-engine is to be used as the motive power, the Local Government Board usually require some auxiliary power to be provided for the purpose of pumping in case the wind-engine should fail to keep up the supply. This is a very wise provision, not only in view of the safeguard afforded by the duplicate pumping machinery, but also because the reservoir may in this case be made much smaller—thus saving cost, without risking the security of a constant supply of water. Prolonged periods of calm occur at rare intervals; and it is seldom that a week passes without there being sufficient wind to do useful work. Therefore, with the provision of some auxiliary power for use in times of extraordinary calm, the size of the reservoir may safely be cut down to a capacity of (say) seven days' supply. The saving in initial cost thus effected will, in the majority of cases, more than pay for the auxiliary machinery, which in all probability would not be required for use more than once or twice in a year.

For small supplies, the auxiliary pumping machinery may very conveniently consist of a horse-gear, coupled to a set of treble-barrel pumps—this class of machinery not requiring to be so carefully protected as, for instance, an oil-engine, nor being so liable to deterioration when not in use. In larger schemes, where a set of double or treble barrel pumps are driven through gearing, these may very easily be disconnected from the wind-engine and driven by a pulley on the countershaft from a gas, oil, or steam engine.

An important point which may be emphasized is that the pumping wind-engine, if kept in proper condition, may be safely left at work both night and day; full advantage being thus taken of any wind that may occur.

The following table will give some idea of the duty which may be expected from various sizes of engines—100 feet being assumed as the total head against which the water has to be lifted. The quantity raised in any particular case would vary approximately in inverse proportion to the total head.

Approximate Average Duty of Pumping Wind-Engines. Assumed Lift, 100 Feet, including Friction.

Diameter of Wheel in Feet.	Revolutions of Wheel, per Minute, in 15-Mile Wind.	Water raised per day, in Gallons, 100 Feet Lift.
10 ..	48 ..	1,200
12 ..	40 ..	2,000
14 ..	34 ..	3,500
16 ..	30 ..	6,500
18 ..	27 ..	10,000
20 ..	24 ..	16,000
25 ..	19 ..	25,000
30 ..	16 ..	40,000
35 ..	14 ..	60,000
40 ..	12 ..	80,000

The figures given in the foregoing table are such as the author has found, from actual experience, may be safely relied on, assuming the site to be reasonably good, and the pump to be properly proportioned for the work. The calculations for the total quantities raised are based on an assumed average of at least 8 hours per day of a wind sufficiently strong to work the engine at average speed. In actual practice, this is found to be a safe assumption. [The author produced a table of working winds which showed that this period is, as a rule, considerably exceeded.]

The velocity of the wind varies persistently from moment to moment, and never for any length of time remains constant. Not only does the record for any hour show a succession of widely varying velocities, but that for any minute can only be given as the mean of several different velocities. Intermittent working only can be expected with velocities from 5 to 10 miles per hour. With velocities of from 10 to 15 miles per hour, steady working at about average speed should be obtained. The amount of work accomplished beyond this increases nearly in proportion to the wind velocity, until a speed of 25 miles per hour is reached, when the engine should commence to regulate itself to prevent damage, and should shut itself completely off in very rough storms. Winds of 5 to 25 miles per hour velocity have a remarkably even duration for every month in the year.

The Folkton water supply, near Scarborough, affords a typical example of a village supply pumped by wind power, of which the following particulars may be of interest: The wind-engine is of the "Simplex" crank type; having a wheel 18 feet in diameter, with hinged canvas sails. It is mounted on a steel tower, 35 feet high, and works a single-acting deep-well pump, 4½ inches in diameter, with a stroke of 8 inches. The well is 55 feet deep; the total lift from the water level to the reservoir being about 130 feet, exclusive of friction. The reservoir capacity is 30,000 gallons; being equivalent to 6 days' supply for the population numbering 400 connected with the service-mains. The average supply per head per day is 12½ gallons. As an auxiliary, there is placed in the same well a set of treble-barrel pumps, 3 inches in diameter by 8 inches stroke, connected to horse-gear, for use in case of emergency—connections being made to the suction and delivery pipes of the 4½-inch diameter pump. Although the reservoir capacity is not large, it has only been found necessary to use the horse-gear pumps on a very few occasions, the cost of such pumping being less than £3 per annum.

The cost of the wind-engine, horse-gear pumps, and well fittings complete was £345, out of a total for the whole scheme of £2280, which included the well, reservoir, mains, and fittings. The cost of attendance is £5 per annum; the attendant visiting the wind-engine once a week and upon special occasions as required.

This scheme was carried out six years ago by the President (Mr. William Millhouse, Assoc.M.Inst.C.E.); a loan being obtained for the purpose from the Local Government Board. The results have been highly satisfactory. Had (say) an oil-engine been used as the motive power in this case, and arrangements been made to pump only one day per week to reduce expenses—for which purpose it must

also be assumed that the well would yield a week's supply in one day—the author estimates that the working costs would, even then, have been more than double what they are at present, and the initial outlay would have been practically the same.

As further examples, the villages of Chesterblade, in Somersetshire, and Great and Little Brington, in Northamptonshire, may be given.

At Chesterblade, the wind-engine is of the fixed steel sail type. The wheel is 16 feet in diameter; the total lift, exclusive of friction, is 125 feet; and the reservoir capacity is 20,000 gallons. About 4000 gallons of water per day are supplied for farm purposes, in addition to a domestic supply for a population of 70 persons. The wind-engine only works about half-time; and the cost of oil and attendance is £5 per annum.

The villages of Great and Little Brington are supplied by an engine of the "Simplex" geared type, with hinged canvas sails. The wheel is 30 feet in diameter; the lift in this case being 200 feet, and the reservoir capacity 180,000 gallons. The population supplied is 600; and the cost of attendance about £4 per annum. A full account of this scheme may be seen in the "Journal of the Royal Agricultural Society of England" for the year 1897, in which it is stated that the engine would be quite capable of supplying more than two-and-a-half times the amount of water actually required.

In the year 1903, some wind-engine trials were held by the Royal Agricultural Society, at their show ground at Park Royal, when 22 engines by 17 different makers were entered for competition. Prizes were awarded for the two engines which, in the opinion of the Judges, were most suitable for general purposes. Before the completion of the trials, the difficulty of comparing the merits of wind-engines of different sizes became apparent; and it is significant that, for the final trials, six engines, each having wheels 16 feet in diameter, were selected, out of sizes varying from 8 feet to 30 feet in diameter. The sizes of pumps were left to the discretion of the makers; a uniform pressure being fixed equal to 200 feet head of water, against which the engines were worked throughout the trials. In the author's opinion, these conditions were unsatisfactory, as no proper comparison of the powers of the various engines could be made (even in the final trials where the sizes of wheels were equal) without first giving a fixed duty per revolution for each size of wheel. An engine loaded for strong winds might show up very badly in light winds against one of equal merit with a lighter load, and *vice versâ*. The trials took place in the months of March and April (strong winds being the rule during practically the whole time), and in the final trials an engine working a pump having a capacity per revolution of wheel practically double that of either of the other five, was far ahead in the duty accomplished. This engine was awarded first prize.

The author will not venture an opinion as to the merits or demerits of the various engines, but submits that these trials failed to show the true relative capacities of the engines, and that a further series of trials, conducted on a better basis, might elicit some very useful information.

In conclusion, the author wishes to state his conviction that the wind-engine for pumping purposes—more especially in connection with village water supplies—has not received the amount of attention from water engineers which it deserves; and he trusts that the few particulars he has here brought forward will be of interest to the members.

Discussion.

The PRESIDENT said, with regard to the Folkton installation, near Scarborough, he furnished the details presented by the author. They were perfectly correct; and the plant had given him great satisfaction. There were many places where wind-engines might be of service—outside districts of towns, where only a limited water supply was wanted. In the Folkton case, the water obtained was sufficient for all purposes with the storage provided; and after six years they found this to be the case. The Local Government Board insisted on the provision of secondary power, and he himself considered the advisability of using an oil-engine; but there was the difficulty of attention and so forth. A wind-engine eliminated all this; and so long as it was kept clean, and oiled regularly, it might be relied upon for a supply.

Mr. WALTER CLEMENCE (London) thought it a matter for regret that Mr. Phelps had not referred more fully to the mechanical details of the various wind-engines he described, because, with engines of modern type, the difficulties of obtaining a long stroke for the pump, and of governing the engine so as to maintain an even speed, were very great. A fact that was brought out strongly by the Agricultural Society's trials was that the mechanical details of many of the engines had been neglected by the makers; and, consequently, the wind-engines failed for various reasons. The engines during the trials pumped against a head of 200 feet, which was somewhat higher than the head referred to by the author in one of the tables he had given. It was found that, as soon as the wind dropped to eight miles per hour, all the engines ceased to pump; and it took a wind of 10 miles an hour to start most of them against a head of 200 feet. With regard to attendance, he must admit that, during the two months' trials, they had 21 practically new engines at work. Of course, when an engine was set to work for the first time, they naturally looked for some small accidents to occur; but though most of the windmills had skilled attendants looking after them, the breakdowns were very numerous. From what he saw during the trials, he should say that the author's estimated expenditure of £5 a year on attendance was far too low. Now with regard to the trials, he thought the author had been somewhat in error in his criticisms. The report showed that many useful comparisons could be made of the designs of the various engines from a careful study of the diagrams and tables drawn up by the Judges; and there was abundance of valuable information to be obtained from the report, which was still the only work dealing with engines of this description. The trials were carried out with great thoroughness; and he had noticed that at shows of the Royal Agricultural Society since the trials were made, various exhibitors of wind-engines had improved the mechanical details of their engines, as the result of the minor faults in detail of design that showed up during the trials. The literature on the subject was still very limited; and the paper Mr. Phelps had read was a valuable contribution to it. But he (Mr. Clemence) thought it rather regrettable that the author criticized the trials somewhat severely in a paper which in other respects was of great value and interest.

Dr. J. C. THRESH (Chelmsford) said one of his chief duties was to try to impress upon rural authorities the desirability of getting supplies of water for their districts. Their chief objection was that they could not obtain them at reasonable cost; and he had had to recommend wind-engines. Within the last two years, he had been instrumental in getting a rural district to put down a wind-engine which pumped an average of 10,000 gallons a day; and the reservoir would hold five times this quantity. Only once in two years they had had to put on the horse-gear. Wind-engines could no doubt be economically used in rural districts; but they were not so economical as the writer of the paper would lead one to expect.

Mr. J. PELLATT RICKMAN (London) remarked that light wind-engines had their birth in the United States; and on the American Continent they were very largely used. There were half-a-dozen makers in the States turning out 10,000 mills a year each. For a country house or farm, where from 1000 to 1200 gallons of water daily were required at (say) 50 feet total lift, no outfit could be more valuable than a mill with a suitable pump. Another thing their American friends had taught them was the absolute necessity of going up high enough to "find the wind." A 5-mile wind was of absolutely no use to turn the wheels of large mills. It took more than 5 miles of wind merely to work the gearing, and much more to lift the water. If they only made the towers high enough, they might be sure of finding the wind. The author had spoken about putting in storage large enough for fourteen days; but he (Mr. Rickman) considered that this was unnecessary. A week's storage was ample. If the mill was fitted so that it could work in a light wind—an 8 or 9 mile wind—they could rely upon 24 hours' pumping every three days on an average. Perhaps he (Mr. Rickman) ought to say that he was interested in the Canadian Imperial windmill, to which the Royal Agricultural Society had awarded the first prize. It certainly did the best work in both light and heavy winds. He had not only had experience of the Canadian mill, but he had been at work three or four years on the American mill; and he believed that water engineers, if they would only "condescend" to it, could make much more use of these mills than they had ever yet done.

Mr. H. ASHTON HILL (Birmingham) said the author spoke of Greenwich representing an inland station of the British

Isles; but Greenwich was not an inland station, and so it would be convenient if the author could give the figures separately as to the average amount of wind blowing from different points of the compass. With respect to the eight hours per day of wind, the author said the calculations for the total quantities raised were based on an "assumed" average of at least eight hours per day of a wind sufficiently strong to work the engine at an average speed. He (Mr. Hill) found, on reference to the figures, that the average was not eight hours; it was more like six or seven.

Mr. WILLIAM MATTHEWS (Southampton) said this question of wind power would be useful where those who had to deal with water supplies over a large area had isolated spots where water had to be provided at a greater elevation than the rest of the district. In such cases, it not unfrequently occurred that the only method hitherto of dealing with it had been to raise the whole of the water up to the reservoir, at what was really an abnormal height having regard to the main district. If they could adopt wind power for raising the small percentage of water required at a high elevation, practically without cost, it was quite as useful a way of doing it as the system was for supplying agricultural districts. The case he had in mind was a supply of about 1½ million gallons per day, most of which would be required for an isolated patch with 200 or 300 inhabitants, at a height varying from 200 to 250 feet above Ordnance datum. At present, all the water required by the entire district was pumped into a water-tower nearly 300 feet high; and obviously there was a lot of wasted power. He had intended to employ a gas-engine, but he might now arrange to raise this small quantity of water as far as possible by wind power, and have a gas-engine merely as a stand-by.

The PRESIDENT, in closing the discussion, said he had nothing to do with the Folkton windmill after it was installed; consequently, he was unable to argue upon actual costs. As to the cost of looking after it, the village blacksmith attended to it. With regard to the paper, it had been valuable because it had brought out a good discussion; and when they supplemented it with the report on the Royal Agricultural Society's trials, the whole would form an excellent contribution to their "Transactions."

Mr. PHELPS, replying to the discussion, said the criticism that had been brought out he had no doubt would be valuable to the Association as an addition to the paper. The mechanical part of the work was more a matter for wind-engine manufacturers than for water engineers, who were only concerned with what the engine would do. Of course, it was useful to know something about the different constructions in choosing a wind-engine; but still he could not go fully into the matter here. He (Mr. Phelps) knew, from experience, that wind-engines did useful work in much lighter winds than 8 miles per hour. But to get them to work in a 5-mile wind, they would have to be lightly loaded. There was an advantage in loading a wind-engine not too heavily. If they could get them to work in light winds, they had the advantage of getting them to work much longer each day than if heavily loaded. He thought Dr. Thresh's opinion as to the amount of storage capacity required, agreed well with the paper—that was, that five days' supply was sufficient. One speaker had said that 8-feet wheels were used to a great extent for private houses. He (Mr. Phelps) had no doubt that was so, especially in America; while in England they were also found useful for supplying single houses. But the idea of his paper, although not stated in so many words, was more to show the value of wind-engines for village water supplies; and for such supplies, nothing less than 10 feet should be used. Mr. Ashton Hill asked whether he could give the difference of the wind velocities between the Edgbaston and Greenwich Observatories. He had not the figures by him; but he took the mean between the two, because he thought it would give a fair result. The difference in the two was practically nothing—not 5 per cent. They agreed very well right through for every month of the year. Kew was another Observatory from which he had also a number of records. This agreed fairly well with the other two stations. Falmouth was very much higher in its records; and in the Scilly Islands, where there were sea breezes the whole time, the records gave an average velocity more than double those of Greenwich and Edgbaston. So that the site had a great deal to do with the amount of wind they would get; and the seaside seemed much better for wind than inland. Mr. Matthews had said that isolated portions of districts might be easily supplied by wind-engines. He (Mr. Phelps) had known this done. In one instance where the water was taken by gravitation for supplying a small town, the pressure was not sufficient to get to some of the higher parts; so a wind-engine was put in to supply a high-level reservoir, and an oil-engine as a stand-by. He believed this had turned out very satisfactory. At Bury St. Edmunds, too, there was a large wind-engine right in the middle of the town (for supplying a high-level reservoir for one part of the district) which had done very good work, supplying an isolated part of the town. Mr. Ashton Hill spoke about the eight working hours per day. The paper stated: "The calculations for the total quantities raised are based on an assumed average of at least eight hours per day of a wind sufficiently strong to work the engine at average speed." The figures he had given showed the average number of hours per day of wind at different hourly velocities for each month in the year, taking the wind over 10 miles per hour (leaving out all under 10 miles per hour) to 25 miles; and it would be seen that right through the year, considerably over eight hours per day was the average amount of working wind. It worked out nearly all the way through to twelve hours per day. In his own experience, a fairly reliable figure, provided the wind-engine was not overloaded, was eight hours.

(4)

WASTE OF WATER AND ITS PREVENTION.

Mr. RALPH BLAKISTON (Liverpool) presented a paper on the above subject. He pointed out that the causes of waste of water are numerous; but, like all mechanical failures, they might be summed up as due to the inefficiency of the appliances used to withstand the strain brought upon them. He said the Water-Works Clauses Act, 1847, was an early effort to cope with the rapidly increasing difficulties; and he showed how the late Mr. Thomas Hawksley was led to introduce high-pressure screw-down taps and improved water-fittings with the object of suppressing waste—an example which had been followed by many towns. The author exhibited a diagram showing the number of people who could be supplied, at the rate of 15 gallons per head per day, with the water escaping through holes of various sizes, from ¼ inch in diameter down to a pinhole, in pipes; and also photographs of a numbcr of defective pipes, with labels indicating the amount of water they had allowed to run away. They gave a good idea of the extent of the waste which may take place in the course of distribution. Mr. Blakiston passed on to deal, as follows, with the various causes of waste and the methods to be adopted for its detection and prevention.

Perhaps the greater enemy of the water-works engineer is frost; and a considerable number of defects found in pipes—many of them having been leaking for years, are due to its action. But undoubtedly much leakage is accounted for by fear of frost also, as consumers frequently turn on their taps during a period of frost and leave them running. Since the bulk of water when frozen is increased in a ratio of 10 per cent., it naturally follows that the material of which pipes and fittings are composed should be able to withstand this expansion. Unfortunately, this expansion leaves a permanent injury, and does not allow the pipe to return to normal. Thus, when the next severe frost sets in, the pipe is not in as good a condition to withstand frost expansion as it was at first; and so on with each succeeding frost until bursts occur.

Many methods have been devised, such as threading india-rubber cords through the pipe, to take up this expansion, but they have not been of any practical value; one difficulty being that it is impossible to tell at what point in the pipe the water will freeze. Under these circumstances, it is desirable to make all lead pipes exposed to frost considerably stronger than would be required for the hydraulic pressure they have to withstand. Much depends upon the quality of the lead of which the pipes are composed. It is often much too hard for the purpose, which is probably due to the introduction of too large a proportion of old lead, which has been several times re-melted.

Other frequent causes of waste may be found in imperfect joints and service-pipes. The author has lately seen some joints which had passed inspection in the pit as perfect, but which in a very short time had given way. Instead of being wiped in the usual manner with a ladle of solder, a benzene blow-lamp had been used; and this apparently had oxidized

the tinning, and prevented the two metals from properly uniting. A specimen of this will show how very treacherous is the foregoing speedy method of making joints. Other causes of waste are defects in pipes and fittings, such as those arising from mains laid too near the surface of the ground—an obvious danger in these days of heavy loads. But these are so well known that we will now pass on to waste due, not to defective fittings, but to defective systems.

1.—Waste due to shutting off long lengths of main of various diameters in order to fix new services.

2.—Waste in hot-water systems fixed in small houses (such as are now being put up on the outskirts of all our large manufacturing towns), where there are no strict regulations in force regarding these systems as to sizes of cylinders.

3.—Waste due to water chilling in the hot-water service pipes.

With regard to the first of these, the use of a special drilling machine for drilling and tapping mains and inserting ferrules under pressure entirely obviates the difficulty.

As to the second, the cylinders in the small houses mentioned are often made to contain only 20 or 30 gallons of water, and the flues are so carelessly constructed that the boiler dampers are mere ornaments, and do not in any way regulate or close the boiler flues. Consequently, the water boils much more quickly than it can be used, and the inmates, in ignorant fear of an explosion, or annoyed by the rumbling noise caused by the generating steam, run the water off to waste several times a day. This may readily amount in many cases to 60 gallons a day per house.

With regard to the third cause, waste due to water chilling can be overcome by simply returning the water to the boiler. A few extra yards of pipe, which in most cases would not amount to 20s. per house, would do all that is necessary to save this considerable waste, amounting often to 10 or 12 gallons per day per house.

There are three well-known methods of waste prevention: (1) House-to-house inspection. (2) The waste-meter system. (3) The house-meter system.

(1) *House-to-House Inspection.*—This method of dealing with waste is very old. It is useful if faithfully carried out; but it is not easy to ascertain if it is being thoroughly done, and the result is not clearly and definitely shown. It is also costly, because search is made in non-wasteful equally with wasteful districts; and the result is partial only. Even supposing the inspector searching a street for waste realized that he was working in a district with little waste, he must not on that account cease to search, because at the very end of the street or district there may be very serious waste. Again, under this method many of the largest sources of waste are not dealt with at all. To give an example: How is an inspector who visits every house in a given street to know that he is in the neighbourhood of a burst main, the water from which, let us say, flows into a stream, or finds its way, as it often does, into a sewer? No sounding within the premises, and in the day time, is going to indicate the existence of such waste.

(2) *Waste-Meter System.*—Under this system, the meter fixed upon the main records the rate of flow at all times passing into the district. It distinguishes between night and day flow. By its means leaks are traced to individual houses, and the volume of waste in the houses and premises is measured. It at once shows results of defects discovered and remedied, and when the district is left, after waste inspection has been made, it acts as a watch dog. Moreover, the volume of waste to be hunted down in each street can by its means be ascertained beforehand, and thus a considerable amount of labour necessarily involved in house-to-house inspection is made unnecessary.

(3) *House-Meter System.*—As regards this system, little need be said. In this country, we pride ourselves upon taking the lead in methods of water supply—we think it better to put no restriction upon the full and free use of water for domestic purposes. The sale of water for domestic purposes by meter, would in many cases lead to restriction in the proper use of water, resulting in dirt and disease.

One of the most important departments of a water distribution is the testing and stamping of fittings. In some cases, this is very thoroughly done; but in others the regulations are not rigidly carried out, with the result that many light and undesirable fittings are introduced. Again, in a large number of water supplies no restrictions whatever are enforced, and thus the plumber is left to his own sweet will. Many water authorities, although insisting on various weights of lead pipe to be used in different parts of the town, according to the hydraulic gradient, do not trouble to make hydraulic tests of such pipe, and merely satisfy themselves by seeing if the lead pipe will tan-pin at each end of the coil. This test is a fairly good one for ductility of the lead; but something more than this is wanted. Breakage of the pipe is often due to continual contraction and expansion, and, in the author's opinion, more crucial tests should be given than merely tan-pinning out the ends. Moreover, the pipes are often of very uneven thicknesses, so that a hydraulic test should undoubtedly be made.

With regard to the testing of fittings, this is a very big subject, upon which almost every water engineer has his own opinion; but the main principle of testing and examining in detail each one, cannot be too highly commended. Certain authorities specify mixtures of which cocks are to be composed, and manufacturers are, of course, liable to be called upon to give proof that the mixture has been worked to. It is doubtful whether this regulation is really of much service. The brass founder—except, perhaps, in some very exceptional cases where the water is full of salt and of a very corrosive nature—is the best judge of the mixture to make a good sound cock. The author has had a good deal of experience in water fittings, and has never seen an ordinary house tap body burst at a pressure of 1000 lbs. per square inch. In fact, one corporation now simply specifies that the tap must have full-way, and all regulations with regard to weight and mixture have been relaxed, and the taps are supplied lighter than perhaps to any other corporation, yet we do not hear of their having any trouble with them. The taps referred to are, of course, the screw-down type, which we may now consider to be universally used, although its birth only dates from 1845. The old plug tap is certainly at least 1900 years old, perhaps a good deal older.

Gas-Engine Trials at Birmingham.

Our contemporary "Engineering" has been informed that the trials on the experimental gas-engine at the Birmingham University which are being made by Professor Burstall for the Gas-Engine Research Committee of the Institution of Mechanical Engineers, are progressing favourably, and will shortly be completed. It is stated that the following remarkable result has been obtained; being some 3 per cent. higher on the thermal efficiency than any previous gas-engine:—

Compression pressure	200·0 lbs. per sq. in.
Mean pressure	89·4 ,, ,,
Revolutions per minute	167·7
Diameter of cylinder	16 inches
Stroke	24 inches
I.H.P.	91·4
Gas per I.H.P. at 0° C. and 760 mm. of mercury	37·55

The calorific value of the gas was 163 B.Th.U. per cubic foot and the thermal efficiency 41·6 on the I.H.P.

Apparatus for Gas Analysis.—Herr A. Bayer, of Brüm, has taken out a patent in the United States for an apparatus for the analysis of gas. It comprises two gas-meters, connected with the gas-pipe, which drive shafts in opposite directions, and an absorbent container connected between the two meters. The motion of the shafts is transmitted by differential gearing to a toothed rim, which engages with a toothed wheel mounted on a third shaft, on which a friction pulley is also keyed. A sliding bar, guided to move vertically, is pressed against this pulley by a spring; and a style is mounted on the bar, and marks a rotary drum. A pinion with a lateral stud may be mounted on one of the first-named shafts, and combined with a toothed wheel, which, on rotating, causes the stud to engage a projection on a pivoted lever, actuated by a spring, and pressed against the pulley—the lever also carrying a friction roller. Before entering the first meter, the gas passes through one compartment of a cooler, and on leaving the absorbent container, it flows through the second compartment of the cooler before entering the last meter. The cooler consists of a vessel with chambers at the ends, separated by perforated partitions from the rest of the vessel. Each chamber is divided by a wall into two compartments, the compartments at one end of the vessel being provided with gas-inlets, and those at the other end with gas-outlets. The holes in one perforated partition are connected by pipes with the corresponding holes in the other partition, and water is made to circulate round the pipes. The apparatus also includes a solid absorbent container, comprising a vessel with a gas-inlet near the bottom, and an annular trough to hold a fatty scaling medium at the top. Into this trough the guttered rim of a cover fits; the cover being provided with a gas-outlet.

GAS STOCK AND SHARE MARKET.

(For Stock and Share List, see p. 909.)

THE Stock Exchange had a rather agitated week before getting a little breathing time by closing for the Christmas holidays. Of course, it was the almost, if not absolutely, unprecedented state of things in the Money Market that pulled the strings. Threatening clouds on the financial horizon get thicker and thicker; and the deafest of banking adders are beginning to unstop their ears to the alarming cry that the country's reserve of gold is utterly inadequate to the business it does. And if the world's output of gold is reduced by the freezing of the South African yield, the situation must inevitably go from bad to worse. But this is a matter which might be regarded as bordering on party politics; and we have no politics and no party. The Stock Exchange drooped from the opening day of the week; and prices in general shrank—excepting an odd rise or two here and there from special causes. On Tuesday, the tendency was much the same—if anything, a bit worse on the rise of the German Bank Rate. On Wednesday, things were very flat; and Consols were done at 85⅝. The nearer Thursday's Bank of England meeting came, the more one quailed at the thought of a 7 per cent. rate. On Thursday morning all hung on the Bank's decision. The meeting was a long one; and outside the tension became acute. The Directors' decision brought some relief; but it was tinged by the reflection, "For how long?" Gradually a calmer feeling supervened, and things became less intense. Business in the Gas Market was just what might be expected with the holiday break hanging over it. Movements were few and slight, and decidedly irregular. In Gaslight and Coke issues, the ordinary, after holding on for three weeks tightly to its price, managed to effect a little advance. Transactions ranged from 98½ to 99⅛ special—a rise of ½ in the quotation. Very little was done in the secured issues. The preference changed hands at 108 and 108⅜; the debenture, at 84½ and 85½; while the maximum was not dealt in. South Metropolitan was quiet and unchanged, with bargains at from 128 to 129. The debenture realized 85½ and 86½. In Commercials, the capital issues were neglected; but the debenture changed hands at 83¼ free. The Suburban and Provincial groups were as tame as the rest. Alliance old marked 20, Brentford new 202½, Wandsworth debenture 80, and West Ham from 102 to 104. Of the Continental Companies, Imperial was done at from 177 to 179 special, Union at 126, and European fully-paid at 24⅝ and 24¾. Among the undertakings of the remoter world, Buenos Ayres marked 11⅞, ditto debenture 95⅞, Primitiva ordinary 7½ and 7 11/16, ditto preference from 5 5/16 to 5 7/16, ditto debenture 95½, River Plate 12¼ and 12½, Melbourne 4½ per cent. 102, and Oriental 153½.

The closing prices are shown in our Stock and Share List on page 909.

ELECTRIC LIGHTING MEMORANDA.

Interrupting Christmas Shopping in Oxford Street—The Slender Protection between Consumers and Darkness - Influenza Microbes in Electrically Lighted Theatres—Unconscious Humour.

CHRISTMAS comes but once a year; and some of us are not disposed to quarrel with Christmas for not putting in a more frequent appearance. Among those who are glad are those electrical engineers whose stations are not altogether up to date, and want something more spent upon them than the price of a few pots of paint. It is a heavy tax on the nerves of some of the engineers to face, not having the storage backbone that the gas engineer possesses, a run of long dark and foggy days about Christmas time, when things have to be kept going at the station at full pressure—a condition that is not experienced to the same degree during the whole of the other eleven months of the year. There is always uncertainty hovering about an electricity station; but when demand, and practically continuous demand, calls for strenuous duty from machinery and men alike, the uncertainty becomes embarrassing, and engenders a most uncomfortable state of mind. However, from the consumers' point of view, it is exceedingly vexatious that the electrical engineer—seeing that Christmas only comes once a year—cannot ensure against putting people just then to a great deal of inconvenience and loss, and (of course, without deliberate intent) aiding and abetting nefarious deeds. Oxford Street has come into a great deal of prominence of late in connection with its electric lighting, about which we entertain the belief that there will be much grumbling over its character and the inconvenience that the position of the standards will occasion, especially in the eastern end of the street. But it is the shopkeepers in Oxford Street who have had to pay dearly for their patronage of the Marylebone Borough Council's electricity undertaking. Notwithstanding all the money that has been spent on the Council's works, the Electric Lighting Committee and officials cannot guarantee even wealthy Oxford Street immunity from a sudden deprivation of electric light. Christmas shopping was in full swing just before six o'clock on Wednesday evening in the West-end; and the Oxford Street shops were thronged, and so were the pavements, with characters good, bad, and indifferent. Without warning, the electric lighting—patronized by these shopkeepers because it is thought to be the lighting of the fashionable—was all extinguished; and so it remained throughout a valuable twenty minutes. There was great alarm; and there were frantic rushes for the humble candle and oil lamp—for the only light some of the shopkeepers had was that afforded by the street gas-lamps which are now being superseded. Shop doors had to be closed; and customers were allowed to filter out by side ones. "It is safe to say," said one manager of an Oxford Street shopping establishment, "that thousands of pounds were lost in sales to Oxford Street on Wednesday night;" and ownership of goods passed without an equivalent value to the rightful possessor. And the Town Clerk of Marylebone told a "Daily Mail" reporter that it was all owing to a "balancer" at the generating-station getting out of gear! What a sad lot of mischief can be done by a perverse "balancer," or a comparatively small accident, at a generating-station. Since this statement was made by the Town Clerk, the Chairman of the Electricity Committee (Mr. E. R. Debenham) has stated that the failure was due to a "a flash-over" on one of the big machines—a trouble to which "electric plants are very liable." While accepting his assurance that "every effort will be made to guard as far as possible against similar occurrences in the future," it will not be comforting to the consumers to know that electric plants are all of them "very liable" to this kind of thing. We must hasten up with stand-by clauses for the gas industry, as such occurrences as that at Oxford Street will cause restlessness among consumers, and they will want the faithful gas at hand. There being value in protection, stand-by service should be rewarded not only in the case of power, but in the case of lighting.

This incident, the numerous failures of electric lighting we have reported during the year, and the lamentable explosion that occurred at the East Greenwich station of the South Metropolitan Electric Light and Power Company on the day following the Oxford Street trouble, all illustrate how slight is the protection that stands between the electricity consumer and sudden deprivation of light during hours of darkness, with inconvenient and perhaps disastrous consequences. That is why the London County Council some time since insisted that theatres should have two separate supplies of electricity from separate undertakings, and why they have not modified that condition further than to permit the distinct supplies being obtained from two different stations of the same undertaking. That being necessary in the case of theatres, it ought to be compulsory in the case of all other buildings used for public purposes, in which electricity alone is relied upon; and shopkeepers who entirely abandon gas for lighting, and put their whole faith in electricity, ought—that is the lesson of the Oxford Street failure—to protect themselves and their customers in the same way as the theatres are compelled to do. In the case of the South Metropolitan disaster, it was one of six large boilers that burst, and unfortunately two men were killed. The accident might have occurred at any works carrying on other operations; but still there is something to be explained in connection with the cause of the accident. It is, however, the effect on the area supplied with electricity from this station with which we are concerned. Only one boiler burst; but still the reports to hand state that several districts were thrown into darkness by the failure of the supply. So far as capacity would admit, the Company have made arrangements for a supply from their Sydenham station. But here we see how the shops on one side of Oxford Street suffered considerable injury by trouble with the machinery at the electricity station; and, in the second instance, how several districts were thrown into darkness by the explosion of one boiler out of six. A single piece of apparatus temporarily disordered, or a boiler bursting, in a gas-works would not subject the gas consumers to similar inconvenience and loss. Between them and such inconvenience and loss are the huge storage holders, which assure continuity of supply.

It can hardly be much to the liking of electricians to learn that "medical men have asserted that the vitiated air of theatres encourages the influenza microbe." These words are extracted from an article in the "Daily Telegraph." From an editorial in the same issue, these sentences are taken: "The substitution of electric light for gas which burnt up the atmosphere, worked marvels in itself; but the full benefit of the change has not been reaped by theatre goers, who still have to brave the perils of chills, and occasionally the miasma of stale and used-up air." Returning to the first article, it is seen that "long ago it was discovered that a cluster of lights in the centre of a ceiling are an excellent medium of ventilation by the drawing up of vitiated air. Accordingly they are largely adopted in theatres, and have special flues above them, through which the bad air passes to the open." Earlier in the same article it is found that "one fact is demonstrated—that a habitually closed room becomes a nursery of micro-organisms, which are by no means distressed by an occasional flushing of fresh air. On the other hand, a room which is habitually well ventilated is greatly disliked by these troublesome minutiæ; and they will avoid it on principle." Now piecing these facts together in this way, we have presented to us certain truths, which will apply equally to rooms and halls as to theatres where electricity is employed. In the first place, we have the information that the vitiated air of theatres encourages the influenza microbe, and that the theatre-goer has to occasionally face a miasma of stale and used-up air. Yet the electric light has been substituted for gas. There is a little fallacy about the burning-up of the atmosphere by gas, seeing that "long ago it was discovered that a cluster of gas-lights in the centre of a

ceiling are an excellent medium of ventilation," &c. Hot air, by the natural order of things, ascends; and if there is a means of escape, it will do so, carrying all noxious air with it, and giving place to fresh air. Thus the up-current produced by gas-lights is very beneficial in ventilation. Were there no ventilation, and were it true that gas-lights "burnt up" the atmosphere, these influenza microbes which appear to be very particular about their habitations, would suffer cremation before they could do any harm. And as they will avoid on principle well-ventilated places, and gas is an excellent ventilator, there can be nothing so useful as gas for the protection of the public against these distress provoking pests. In ordinary rooms, the householder cannot very well have the buzzing and more or less effectual electrically worked ventilators; and therefore, with heavy atmospherical conditions outside, he may depend upon producing in electric lighted rooms those comfortable quarters that are favoured by the influenza germ. It is not our business to more than take note of this matter; it is the business of the electricians to disprove, if they can, that the vitiated air of theatres now commonly lighted by electricity encourages the influenza microbe.

We sometimes come across bits of unconscious humour in following up electricity matters. The other day an electric radiator was exposed in a shop doorway of a Fleet Street dealer. To it, was affixed a card bearing the words "Expensive Radiator, £1 1s." Into the announcement, it was quite possible to read two or three meanings. Another instance is found in a recent issue of the "Ilford Recorder." There has been a controversy in the paper upon public lighting by gas and electricity; and a correspondent has suggested that the Gas Company and the Electricity Department should take part in a street-lighting competition, to test the relative merits—including, we presume, cost as well as lighting power—of the two illuminants. A writer of editorial scraps in the paper named is reminded by the suggestion of a young fellow who had won a goose in a raffle. When the winner's name was announced, another man went up to him, and said: "Now, I will toss you to see who is to have the goose, you or I." The editorial writer's friend had had "a glass or two," and "was not in a fit condition to reflect that the goose was already his own, and that the other man might win, *and could not possibly lose*. I am not supposing that the Ilford Council will play into the hands of the Gas Company in the disinterested manner suggested." From the Gas Company's point of view, nothing could be funnier than this editorial struggle to say something wise. We do not suppose a "glass or two" would upset the members of the Ilford District Council; and we quite agree that the Gas Company could not possibly lose in the competition. The complete editorial testimony as to the superiority of incandescent gas lighting that is suggested by the words as to playing into the hands of the Gas Company in the last sentence of the above quotation, will be appreciated by the Company; but at the same time, we have been labouring under the impression that the first duty of local authorities is to administer the affairs of the ratepayers with economy combined with efficiency. If, considering both efficiency and economy, incandescent gas-burners are superior to electric lamps, then it is the duty of the Council to act accordingly.

PUBLIC SERVICE CORPORATIONS BEFORE THE UNITED STATES SUPREME COURT IN 1905.

By Alton D. Adams, Attorney-at-Law, Worcester, Mass.

State legislation relative to public service corporations is on the increase; and these corporations are appealing more and more to the Federal Courts for adjudications of their rights as opposed to Statutes and the Acts of local authorities. Where relief from some form of State regulation is desired, it becomes necessary for the corporation to show that some one of their rights protected by the constitution of the United States is about to be violated, before the Federal Courts can interfere. Since Chief Justice Marshall wrote the opinion of the United States Supreme Court in the celebrated Dartmouth College Case, corporations have found the constitutional provision against State laws impairing the obligations of contracts a bulwark for the protection of their rights, in cases of expressed or implied agreements with State authorities.

Another fertile ground for the nullification of State laws bearing on public service corporations has been the commerce clause of the Federal Constitution, which vests in Congress the paramount control of transportation and communication agencies between the States. It remained, however, for the fourteenth amendment, which followed the Civil War and was primarily designed to protect the negro, to furnish corporations with a more complete defence against unjust State action, by the provision that no State shall deprive a person of property without due process of law. Without attempting to enumerate every provision of the Federal Constitution under which the legislative action of States may be reviewed, it may be said that the three just named are perhaps the most important in this respect, and cover a wide range of cases. All provisions of the Federal Constitution are, of course, equally binding on the State and the United States Courts; but after the highest Court of a State has passed judgment on the rights of a corporation under any of these provisions, there is still open to the corporation an appeal to the Supreme Court of the United States.

It is this power of review over the decisions of State Courts, in cases where questions arising under the constitution of the United States are involved, as well as the original concurrent jurisdiction of the Federal Courts with the State Courts in such cases, that give the decisions of the Supreme Court of the United States their great importance to public service corporations. Constitutional questions in connection with the legislation of States and their municipal corporations are so nearly similar in the cases of gas, water, electric supply, and traction companies, that a decision of the United States Supreme Court on such a question as to one of these companies is usually of interest to all the others.

Dawson *v.* Columbia Trust Company. Decided March 27, 1905.

This was a suit in equity to restrain the city of Dawson, Georgia, from building water-works, and to compel it to specifically perform a contract to purchase for twenty years water from the Dawson Water-Works Company. The Trust Company, as mortgagees of the Water Company, were entitled to collect the water-rentals. To this the latter Company assented; but the city refused to pay. While the Water Company were made party defendants, this was evidently done for the purpose of giving the United States Courts jurisdiction, through diverse citizenship; the Trust Company being a Pennsylvania Corporation. The Water Company, a Georgia Corporation, had previously brought a suit in the State Court, against the city on their contract, and had failed.

On these facts, the Supreme Court denied its jurisdiction in the case, saying that "when the arrangement of the parties is merely a contrivance between friends for the purpose of founding a jurisdiction which otherwise would not exist, the device cannot be allowed to succeed." After making the contract with the Water Company, the city voted to issue bonds for the construction of water-works and an electric light plant; and the amended bill of the Trust Company alleged that the Acts of the city, as to the construction of the water-works and the refusal to pay the agreed water-rates, impaired the obligation of its contract and deprived the Trust Company of their property without due process of law.

In reply to this contention, the Court said that the bill presented a naked case of breach of contract, and that the mere fact that the city was a municipal corporation did not give its refusal to pay under the contract the character of a law impairing the obligation of contracts, or deprive a citizen of property without due process of law. After the city made its contract with the Water Company, there was no State legislation authorizing it to build water-works; and it did not appear that there was such legislation before. The Court distinguished the principal case from that of *Vicksburg Water-Works Company v. Vicksburg*, where the city made a contract with the Water Company, and subsequently a law was passed authorizing the city to build water-works. Under this law, the city started to build works, and denied liability under its contract; and the Supreme Court held that this presented a case under the United States Constitution. In the present case, two of the nine justices dissented, and one took no part.

New Orleans Gas Company *v.* Drainage Commission.
Decided April 3, 1905.

This case came up on a writ of error from the Supreme Court of Louisiana, on the contention by the Gas Company that their contract rights had been violated, and their property taken without compensation, in derogation of the Federal Constitution. Prior to 1896, the Gas Company had obtained the exclusive right to distribute gas through the streets of New Orleans during a term of years, through several grants by the Legislature of Louisiana, and the location of their pipes in accord therewith. In that year the Legislature created the Drainage Commission of New Orleans, with power to construct a drainage system for the city. To allow the construction of the system of drainage on the plans of the Commission, it proved to be necessary for the Gas Company to move some of their pipes to new locations. Suit was brought by the Gas Company in the State Courts to recover the cost of this removal of their pipes; but the Supreme Court of Louisiana refused to allow a recovery, and an appeal to the United States Supreme Court on the grounds above stated was the result.

In deciding the case, the United States Supreme Court admitted that the Gas Company had a contract covering the exclusive right to distribute gas by means of pipes beneath the surface of the streets in New Orleans, and referred to the case of *New Orleans Gas Company v. Louisiana Light Company*, in which this point was distinctly decided. The fact that the Gas Company had been put to expense in moving their pipes was also admitted; but the Court held that the expense was not of a sort for which the Company were entitled to recover from the city. The reasons given for this decision were that the legislative grant to the Gas Company did not give them a right to any particular location in the streets; that the grant provided for the laying of pipes with due regard to the public convenience; that the drainage of the city was an exercise of the police power; that this power, in so far as it is essential to the health of the community, cannot be contracted away; and that rights and privileges arising from contracts with a State are subject to regulations for the protection of the public

health, the public morals, and the public safety, in the same sense, and to the same extent, as are all contracts and all property, whether owned by natural persons or corporations. It was also said that the public control extended as fully to the sub-surface as to the surface of the streets. The expense incurred by the Gas Company in the removal of the pipes was *damnum absque injuriâ*. The Court was unanimous in this case.

SAVANNAH RAILWAY *v.* SAVANNAH. Decided May 15, 1905.

This was an appeal from a decision of the Georgia Supreme Court, in which an injunction to restrain the collection of a municipal tax was refused. By its ordinance of March 22, 1899, the City of Savannah required street-railroad companies using its streets to pay $100 per mile or fraction of a mile of track within its limits, for the privilege of doing business, and for the use of the streets. The Savannah railway derives most of its earnings from the operation of electric passenger cars in the streets of the city. One part of the bill of the railway set out that there was no law in Georgia to authorize the imposition of the tax; and the Supreme Court of the United States said that if this were true the foundation of its jurisdiction would be gone, and the writ of error would be dismissed. But as the State Court had decided that the tax was authorized, the other points raised by the bill were considered. One ground of attack on the validity of the tax was the fact that the Central Georgia railway was not subjected to it, though this railway transported freight from its regular station to various side-tracks, through the streets of the city, and made a charge for this service. The Central Georgia railway, operated with steam, did most of its work outside Savannah; and the Supreme Court of Georgia had held that it was subject to taxation by the State alone. As to this point, the United States Supreme Court said that the difference between the railways was obvious, and warranted the diversity in the mode of taxation. The other objection urged against the tax was that it violated a contract between the Savannah railway and the city, by which the railway was allowed the right to operate in certain streets, and in return granted to the city certain lands. In the opinion of the Court, this last objection was an attempt to go behind the decision of the State Court, that the tax is a tax on business, and to make out that it was a charge for the privilege of using the streets. As a matter of construction, it was held that none of the expressions in the contract between the railway and the city imparted any exemption from taxation, even if it was within the power of the city to grant it. There was no dissent from this decision.

TAMPA WATER COMPANY *v.* TAMPA. Decided Nov. 13, 1905.

This was a writ of error asking reversal of the decree of the Florida Supreme Court against the Water Company. In the bill it was alleged that an ordinance of the city of Tampa violated a contract of the city with the Water Company, by which the Company were authorized to charge certain rates for water for a period of 30 years. The ordinance in question fixed lower rates for water than those named in the contract, and imposed a penalty for a refusal to furnish water at these lower rates. At the time that the contract between the city and the Water Company was made, the State Constitution provided that "the Legislature is invested with full power to pass laws for the correction of abuses, and to prevent unjust discrimination and excessive charges by persons and corporations engaged as common carriers in transporting persons and property, or performing other services of a public nature, and shall provide for enforcing such laws by adequate penalties or forfeitures." On a later date the Legislature enacted that cities, towns, and villages might fix reasonable maximum water-rates, provided that such rates should not impair any valid contract. In view of the construction of the Act by the Georgia Court, it was held by the United States Supreme Court that there was no question as to its constitutionality. Whether the ordinance was valid thus depended on the construction of the above clause of the Florida Constitution, because the contract in question was made after the clause went into effect. The Florida Court had decided, in effect, that the power to fix rates conferred by the Constitution on the Legislature could not be contracted away. In its opinion, the Supreme Court said that this was a possible interpretation of the State Constitution, and that while this Court construed the Constitution for itself, and determined whether the obligation of a contract had been impaired, still the Federal Courts will lean toward agreement with the State Courts where the question seems in doubt.

It was urged against the validity of the ordinance that the Legislature would have had the power to fix rates without the above provision of the State Constitution, that this power could then have been cut down by contract, and that under the existing Constitution this could still be done. To this, the answer of the Court was that the words "full power" might mean power that could not be cut down, and that this view was strengthened by the requirement that the Legislature "shall" provide for enforcing the laws which it was to pass for the prevention of excessive charges. There was nothing to show that the rates fixed by the ordinance were unreasonable, and so invalid as taking property without due process.

Seven justices agreed in this opinion, affirming the decree of the Florida Court. Justices Brown and Peckham dissented, on the ground that the Tampa ordinance fixing rates violated the contract with the Water Company.

RECENT RAILWAY ACCIDENTS AND THE SAFETY OF GAS LIGHTING.

THE public has been pretty well bombarded of late, by those whose interest it is to extol the virtues of electric lighting, with references to the so-called vast superiority of their system of lighting from the point of view of safety; and, in the campaign, there has been no hesitation to make use (for the purpose of traducing gas lighting generally) of the attacks that Lieut.-Col. von Donop, one of the Inspectors of the Railway Department of the Board of Trade, has made upon the use of gas for lighting railway trains. Under the circumstances, it may not be altogether futile to inquire whether there is any substantial cause, from the standpoint of the public interest, for his aversion to gas lighting. Lieut.-Col. Donop's latest report, in which he again opposes gas as a railway illuminant, has relation to the deplorable railway disaster at Grantham; and we really fail to find that his conclusions have anything more tangible for their support than assumption, as has been the case in former reports from the same quarter. Not the slightest justification appears to be procurable from the evidence.

We are quite alive to the importance of, above all things, ensuring the safety of the travelling public, but are equally alive to the fact that there has been no evidence adduced up to the present to show that gas as an illuminant for train lighting is not equally as safe as electricity. There is no doubt that great anxiety is felt by many interested in electricity at the considerable strides made by the introduction of incandescent gas mantles for the lighting of trains, and especially by those who are concerned in the fitting up of trains by electrical apparatus. For our own part, we are only interested in the matter from the point of view of the prevention of any detrimental influence being brought to bear upon the gas-lighting industry by mistaken notions, prepossession, or whatever it may be, and the active use made by competitors of official views arising from one or other of such causes. We cannot shut our eyes, nor do the gas industry's competitors, to the commercial value to any system of lighting of such public exposition as the illumination of railway carriages gives. Hence the strenuous efforts of the electrical competitors to stem the ever-rising tide of favour with which the system of incandescent gas lighting is regarded by railway engineers; hence, too, our endeavour, in face of the experience as to safety over a long course of years, to counteract those efforts.

Before proceeding, let us see what Lieut.-Col. Donop says, on the question under consideration, in his report on the Grantham disaster. Among the opening paragraphs, he observes:

> The whole of the vehicles were lighted by gas with the exception of the eighth and ninth vehicles—namely, the sleeping car and composite carriage. These two vehicles were lighted entirely by electricity; but the sleeping car was also provided with a small gas cylinder for cooking purposes.

Then the important paragraph, in connection with our subject is the last one, in which the Inspector points out that fires broke out among the wrecked vehicles immediately after derailment. Then these sentences follow:—

> It appeared that the *first* vehicle which caught fire was the ninth vehicle of the train which had come to rest half way down the embankment, with its centre resting quite close to the fire-box of the engine. The central portion of this vehicle, which it should be noted was *one of those lighted by electricity, was badly burnt*. But there can, I think, be no doubt that the fire on this vehicle originated from the engine, and that it then spread to the other carriages lying near it. With regard to the fire amongst the vehicles at the bottom of the embankment, it was *impossible* to obtain any definite evidence as to how it orginated. It may also have been due to fire from the engine; but from the suddenness with which the fire broke out, and from the fierceness with which it burnt, it is difficult to resist the conclusion that it was more probably due to an escape of the gas with which those vehicles were lighted. In any case, it seems certain that its intensity was considerably increased from that cause; and I consider that this accident points, as previous accidents have already done, to the unsuitability of gas as an illuminant for railway vehicles.

And why? It is an amazing thing that out of so much inconclusiveness anyone should feel security in drawing so definite a conclusion as that contained in the last twenty words, more especially in view of what is said as to the first vehicle that caught fire being an electrically lighted one, and that it was badly burned. If the fire originated from the engine in that case, there is just as good reason to suspect that the one cause applies to the whole. Really, we fail completely to comprehend why Lieut.-Col. Donop should go out of his way to attempt to discredit a system of illumination which has proved beyond question to be the safest, most economical, and most efficient method of lighting railway vehicles ever devised. The system is no new, untried thing. It is a system that has a clean record of nearly thirty years' service, a system that is almost universally used, and a system that has received the approval of the world's railway engineers. Therefore to state at this date that it is "unsuitable for the purpose" is extraordinary, and postulation pure and simple. When we say that the lighting of railways trains by gas has a "clean record," we do so advisedly, as in no instance during its long service—a service which now embraces the lighting of upwards of 200,000 coaches, not to mention locomotives and horse vehicles—has there been evidence to show that it has caused

fire, neither has it been proved that it has even added to one. If the merits or demerits of a system are to be judged by hypothesis only, why, we ask, is not this method applied equally to electricity? Why are not the many horrors—horrors more easily imagined than described—of burst accumulator-boxes, and the inevitable distribution of large quantities of dangerous acid over unfortunate passengers pinned beneath the wreckage dilated upon? Why is no reference made to the ever-present and serious danger of fire from the fusing of electric circuits—a danger fully recognized by Major Pringle in his report on the Cudworth accident, in which two electrically-lighted coaches were destroyed by fire Or if the safety of gas is in question, why is no mention made of danger from that given off from the batteries? Again we ask, "Why?"

As in this connection it will be interesting to review the reports of recent railway accidents when the question of the illumination of rolling stock has been touched upon, we give below extracts from those submitted by the various Board of Trade Inspectors. It is refreshing to note the absolute impartiality of the statements by Major Marindin and Major Pringle.

Major Marindin's Report on the Thirsk Accident, Nov. 2, 1892.

It should here be mentioned that the evidence makes it quite clear that the fire was not in any way due to the fact that the train was lighted by compressed gas, and it is nearly certain that it was caused by the wreckage catching light from the engine fire.

Major Pringle's Report on the Cudworth Accident, Jan. 19, 1905.

I have endeavoured to find out how the carriages of the up-express caught fire after the collision, but have failed to do so. Statements vary as to which coach first caught fire. It appears to have originated in either the fifth or sixth vehicle behind the engines. I am informed that both these coaches—one being an eight-wheeled bogie third-class coach, and the other a twelve-wheeled bogie sleeping car—were lighted by electricity, and that the only gas-reservoir was a small one on the sleeping car, which is utilized for heating water for the use of passengers. The fire did not break out immediately, but first appeared five minutes or more after the coaches had come to rest. Whether it was due to fire thrown out of the engine fire-boxes, or to *fusing of electric circuits*, or to gas, there is no evidence to prove.

Lieut.-Col. von Donop's Report on the Witham Accident, Sept. 1, 1905.

Attention should also be drawn to the fact that one of the carriages was destroyed by fire, owing to the ignition of the gas in the cylinder underneath the framework. Fortunately no lives were lost thereby on this occasion; but the occurrence points to the desirability of adopting some other source of illumination, probably electricity.

Lieut.-Col. von Donop's Report on the Catesby Tunnel Accident, Jan. 4, 1906.

One other point in connection with this accident calls for mention. Three of the vehicles on the train were lighted by gas. All the lights in these vehicles were at once extinguished by the derailment and there was in consequence a great escape of gas. Fortunately, the officials of the Company who were travelling in the train noticed the smell; and they at once took prompt measures to keep all naked lights away from these vehicles. Danger was thereby averted; but it is terrible to contemplate what might have been the results of this accident if an explosion had occurred or a carriage had caught fire in the tunnel. The leading and rear vehicles of the train were both lighted by electricity. The lights in the latter were extinguished; but in the former vehicle, they remained alight throughout, and were of the greatest assistance in rescuing and controlling the passengers. This accident furnishes therefore another instance showing the undesirability of the employment of gas as an illuminant for trains, and the superiority of electricity for that purpose.

With reference to the Witham accident, the report does not disclose any evidence whatever to show how the coach took fire; and yet Lieut.-Col. von Donop makes a distinct statement to the effect that this was caused by gas, and suggests the use of "some other illuminant, probably electricity." Again, regarding the accident at Catesby Tunnel, he states that, owing to the lights being extinguished in three of the vehicles, there was a great escape of gas; and he enters into suppositions as to what might have happened had this gas caught fire, or had there been an explosion. In this case, he openly advocates the use of electricity. In the report there is no indication that inquiry was made as to the amount of gas carried per coach, or that any details as to the amount of gas which was being passed by the gas-burners were taken; neither is it stated that the railway officials present were, or were not, competent to judge as to the danger of fire. Yet notwithstanding the fact that no fire took place, the system is again not only branded as suspect, but is broadly condemned, by Lieut.-Col. von Donop, and electricity is once more advocated. The evidence of Thomas Male, carriage examiner, shows that no defects at all were found in the undergear of the coaches, after a thorough examination. This makes it quite clear that the gas connections satisfactorily withstood the shock of the accident, and that there was no defect in the cylinders. The only escape of gas, therefore, that could have taken place must have been from the burners in the roof lamps; and from inquiries made as to the escape of gas from burners used for train lighting, we find that the maximum amount passed per burner is only about 0·75 cubic foot per hour. Nevertheless, this small amount (which could not by any possible chance have formed an explosive mixture in the tunnel) is magnified into a "great escape of gas." That a smell of gas might have been in evidence, we admit; but those conversant with oil gas know that a very small quantity will cause this, owing to its distinctive and pungent odour—a peculiarity which largely makes for safety in its use. It is, of course, quite conceivable that railway officials inexperienced in gas lighting, and with their nerves shaken by the accident, may have imagined a danger which had no existence.

Reverting to the Grantham accident, there is again no evidence to prove that gas was the cause of fire. On the contrary, it is distinctly declared that it was impossible to obtain any definite evidence as to how it originated, but it may have been due to fire from the engine. Strange it is, in face of this, that gas should be again "dragged in." As already mentioned, the first coach to catch fire was an electrically lighted one. It was badly burnt in the centre—the position of the accumulator-boxes; the fire apparently originating in the first place from the engine. No suggestion is made by Lieut.-Col. von Donop as to the intensity of the fire being increased by any accumulation of gas from the batteries. But there is no reason why his supposition should not have also turned in this direction.

To sum up, the reports of the accidents, so far as they refer to the subject in hand, indicate the following facts:—

THIRSK.—It was quite clear that the fire was not in any way due to the fact that the train was lighted by gas.

CUDWORTH.—No evidence to prove how the fire broke out; but it might have been caused by the engine, by the fusing of electric circuits, or by gas. [*Note.*—The coaches were electrically lighted; and only a small gas cylinder was carried for the purpose of heating water.]

WITHAM.—It is stated that the fire was caused by gas; but there is absolutely no evidence to this effect.

CATESBY TUNNEL.—Three vehicles lighted by gas, but no fire.

SALISBURY.—Entire train lighted by gas, but no fire.

From the above, it is interesting to note that the, what may be termed, "anti-gas" reports emanate from one inspector. But there can be no doubt that the safety of gas as an illuminant is clearly proved, even if no account whatever is taken of its many years of efficient service. Regarding electricity, there may be seen in the coaches of at least one of the electric railways in London, conspicuous notices to the effect that the wood work has been rendered proof against fire. This, in itself, is sufficient to prove that, where electricity is used, precautions against fire are necessary. Moreover, it cannot be said that the illumination of railway coaches by electricity has passed the experimental stage. The comparatively few coaches at present fitted have been found expensive in first cost of apparatus, expensive in maintenance, the apparatus is uncertain in action, a specially trained and experienced staff is required for continual "nursing," and the average light produced is no better than that yielded by properly regulated flat-flame gas-burners. Between the new system of carriage illumination by means of incandescent gas mantles and the electric light, there is no comparison. The light of the new lamps is not only infinitely superior to the electric light, but the cost of installation is much less; while the consumption of gas is so much reduced that the quantity necessary to be carried per coach is far less than formerly, with a consequent reduction in the expense of lighting.

It is altogether beyond comprehension why, among the Inspectors of the Board of Trade, Lieut.-Col. von Donop should alone have taken up the attitude he has done, without testimony being advanced that experience justifies his action. This experience does not do.

MUTUAL COMPENSATION SCHEMES.

WE always look with much interest to the issue of the reports of the Chief Registrar of Friendly Societies, as they contain particulars regarding the mutual schemes which are in certain cases in operation between employers and employed, with the object of securing to the latter the benefits—or more than the benefits (they must at least be as favourable to the workmen)—which are provided by the terms of the Workmen's Compensation Act of 1897. These schemes, which must be optional for the men, constitute the "contracting-out" clause of the Act; and their fairness is ensured by the fact that they must be submitted to, and approved by, the Registrar. They are certified for a period of not less than five years; but it is to be noted that the number of them does not increase very rapidly. The report of the Chief Registrar (Mr. J. D. Stuart Sim) for the year ended December, 1905, records the certifying of three new schemes, and the renewal of one. Of the former, one relates to a modification of a scheme for workmen in Government establishments; while the other two new ones, and the renewed scheme, relate to persons employed in coal mining and coal and coke shipping. No further adherents to the plan have been forthcoming from among the gas undertakings of the country; the South Metropolitan and South Suburban Gas Companies being still the only representatives of the industry included in the report.

Referring to last year's schemes, it may be mentioned that in all cases the provision for injury dates from the time of the accident. In the Government establishments, the compensation in case of death is the same as is provided for by the Act. During incapacity from work, there is allowed half the average pay for the preceding twelve months for a period of six months, with medical attendance; and in the event of permanent disablement, from one-tenth to two-fifths of the average pay, according to the

nature of the incapacity. There is no mention of any contribution to the fund by the men. But in each of the other new cases, the men hand over from 1½d. to 2d. per week.

There have been about ninety of these mutual compensation schemes certified since the Act came into operation on July 1, 1898; but some ten of these have now ceased to exist, while the number has been still further nominally reduced to a very considerable extent by the process of amalgamation. The returns for the year ending June 30, 1905, show that in the case of the one Railway Company—the Great Eastern—who have a scheme in operation, there were 28 deaths from injury in the twelve months, while 2991 men were incapacitated. Each workman appears to have contributed 1d. a week, which realized £6030; while the Company gave £11,253. Eighteen schemes in connection with factories of different kinds in England and Wales have been adopted by 19,105 workmen out of a total of 20,465, which shows that these schemes, where set in motion, have been popular enough among the employees. The men referred to contributed in the aggregate £2782, or about 2s. 11d. each (in three schemes all the contributions were paid by the employers), and the masters £5777. The payments on death (four cases) were £1274 (besides some pensions granted to dependants); during incapacity, £3693; and for other benefits, £1629. The funds at June 30, 1905, amounted to £10,225. Twenty-five schemes in active operation in connection with mines have been adopted by 48,532 workmen, who contributed £25,627, as against the employers' £32,252. The total payments for cases of death (54) were £9747; during incapacity, £33,611; and for other benefits, £9636. The average contribution made by each workman was a little over 10s. 6d.; and the funds at the end of the year amounted to no less than £165,355.

There were, beyond these, two schemes in connection with quarries; and a further two certified in Scotland. In the aggregate the schemes referred to had been adopted, at June 30, by 100,215 workmen, who contributed during the year £35,221; while the employers contributed £51,252. The payment on death was £15,422; during incapacity, £50,472 (of which £17,727 was paid for the first two weeks of incapacity for all cases, £27,686 after the first two weeks, and £5059 in lump sum payments); and for other benefits, £11,646. The average contribution of each workman was 7s.; and the funds were £185,570. The number of deaths was 87; and of cases of incapacity, 16,147. In 26 of the cases a comparison was furnished between the amount actually paid during incapacity and the maximum that would have been payable under the Act; and the difference was found to be 57 per cent.—of course, in favour of the workmen, in view of the stipulation that all schemes must be at least as beneficial to them as the Act. In nearly 49 per cent. of the total number of cases of incapacity, the duration was two weeks and under; and the £6623, or an average of 17s. per case, paid away in this way, was all in the nature of a return to the men for their contributions, as, of course, for these accidents they would have received nothing under the Act. In 169 cases (or 1·05 per cent. of the whole) the incapacity exceeded 26 weeks; the average duration being just over 69 weeks, and the cost to the funds £36 10s. for each, or 10s. 6d. per week of incapacity. From returns giving information as to the estimated maximum amount that would have been payable under the Act, it would appear, remarks the Registrar, that the workmen would have been entitled to receive £5862; whereas the amount actually paid to them under the schemes was £9784. Payments of gross sums amounting to £5059 were also made during the year in respect of cases of incapacity.

With regard to the schemes of the two Gas Companies named, the report shows, in the case of the South Metropolitan Company, that during the twelve months ended June, 1905, the whole of the men employed—that is, 6283—joined the mutual scheme; their contribution amounting to £513, and that of the Company to £1178. The payments made were: To dependants as the result of death, £556; for incapacity, £891; and other benefits, £30. There were 256 cases of incapacity, but no deaths. In the South Suburban Company, also, the whole of the men—600—"contracted out" of the Act; their contribution amounting to £53, and that of the Company to £119. The payments were: In cases of incapacity, £57 (as compared with an estimated maximum amount of £25 which would have been payable under the Act); and other benefits, £8. The number of cases of incapacity was 27.

The earliest sub-aqueous aqueduct tunnels in America were those built at Chicago in 1864-7, two miles long, at a cost of $457,844, and subsequently extended four miles further for a fresh water supply. A second conduit, 8 feet in diameter and about 4 miles long, was added in 1887-92, and also at Cleveland in 1869-74, when a 5-feet conduit, 6606 feet long, was built.

At the meeting of the Glasgow Association of Students of the Institution of Civil Engineers on the 17th inst., Mr. James Lowe, Assoc.M.Inst.C.E., of the Glasgow Corporation Gas Department, read a paper on "Gas Supply." The author dealt with gas-works construction and equipment generally, but cited many illustrations from the Provan Gas-Works. Gas plant from the chemical and engineering standpoints was first dealt with, followed by descriptions of the many mechanical and labour-saving appliances now used. The structural features of gas-works, with special reference to the design and erection of gasholders, were then treated of; and an interesting discussion followed.

GAS-ENGINE FAILURES.

In no field more than the mechanical is the truth revealed that from failure improvement springs. It shows us what to avoid, it exposes weaknesses; and it sets the worker to discover that which makes for betterment. Failure, it is true, is an unwelcome visitor; but its stimulating effect is far-reaching in its results. Each year we look for, and peruse with interest, the report of the Chief Engineer of the British Engine, Boiler, and Electrical Insurance Company, Limited (Mr. Michael Longridge, M.A., M.Inst.C.E.), on accidents with steam, gas, and oil engines, and electrical plant. It is a record of failure of individual parts of plant; and those failures disclose weaknesses, and, in cases it may be, latent sources of danger in similar plant. The reports are therefore highly instructive, and the lessons have great value. The report for the year 1905 possesses in these respects the characteristics of its predecessors; and from it, as from former ones, there is something new to be learned. The report extends to 72 pages of printed matter, and is supplemented by an appendix of figures and diagrams.

In noticing the contents of the report so far as they specially appeal to us, we cannot do better than begin by reproducing the following table, which presents, in comparison with preceding years, the proportions in which the various parts of insured gas and oil engines that broke down in 1905 caused or initiated the breakdowns. But we repeat what has been advanced before, that it would be a convenience if Mr. Longridge would discriminate between gas and oil engines by giving separate tables to them.

Gas and Oil Engines.

Description of parts which are believed to have given way first.	21 Years previous to 1903.	During		
		1903.	1904.	1905.
Valves and valve-gear	32·9	28·2	31·3	30·1
Cylinders and cylinder ends	16·5	21·4	14·8	15·9
Pistons	12·3	12·6	4·6	6·2
Connecting-rods and bolts	11·0	7·8	10·2	10·6
Main shafts	4·1	5·8	10·9	15·9
Governors and governor gear	4·1	5·8	10·2	5·3
Silencing-boxes and exhaust-pipes	4·1	1·9	6·3	5·3
Clutches and couplings	4·1	0·0	0·0	0·0
Fly-wheels	4·1	5·8	8·6	3·5
Bolts	2·7	5·8	0·0	2·7
Frames and pedestals	2·7	3·9	3·1	0·9
Total wrecks, cause not ascertained	1·4	0·0	0·0	0·0
Main driving ropes or belts	0·0	1·0	0 0	0·9
Starting gear	0·0	0·0	0·0	1·8
Gas-producer plant	0·0	0·0	0·0	0·9
	100·0	100·0	100·0	100·0

The figures in this table do not represent much improvement in the reduction of proportions of accidents arising from parts. In the last two years, "pistons" have made a most material advance in good behaviour compared with 1903 and previously; but last year was a little worse than 1904. The item of governors and governing gear exhibits a better state than in 1904; and so do the lines "fly-wheels" and "frames and pedestals." "Main shafts," however, are the worst feature. "Starting gear" has, for the first time, an entry against it; and gas-producer plant is beginning to take a place.

The succeeding table indicates that at least 56 per cent. of the accidents in gas and oil engines are preventible. The figures are a rough classification of causes to which the accidents are due—

	Per Cent.
Accidents, or causes unascertained	44
Negligence of owners or attendants	18
Old defects and wear	13
Weakness, faulty design, or bad workmanship	25
	100

The three last items are anything but satisfactory. It is gratifying, however, to learn that the rate of breakdown among gas-engines in 1905 was slightly lower than in 1904, and decidedly lower than the rate among steam-engines. But this statement must be qualified by observing that the gas-engines insured are for the most part small ones, which, in the present state of gas-engine design and construction, are more reliable than those of larger power. If the comparison were made with small steam-engines only, it would probably be found that the inequality had disappeared, or even turned in favour of the latter. The figures given in the first table show that more than 70 per cent. of the breakdowns of gas-engines fall into one of the following four classes:—

	Per Cent.
Valves and valve gear	30·1
Cylinders and cylinder ends	15·9
Connecting-rods	10·6
Main shafts	15·9

It is to these parts, therefore, that designers and constructors of gas-engines should specially turn their attention. Of the break-

ages of valves and valve gears 80 per cent. can be classed under three headings only—

	Per Cent.
Valves and valve spindles	29·6
Helical wheels driving side shafts, and brackets carrying shafts	23·6
Levers for working valves	26·5
	79·7

Stronger spindles, as far as possible without screw threads or large holes for split pins, better lubrication, and prevention of end movements on side shafts, and stronger levers for working valves, would, Mr. Longridge points out, materially contribute to the reliability of gas-engines. Cylinders and cylinder ends are being improved, and forms and material which will stand high pressures and temperatures for long periods will, it is hoped, be found in course of time. The only general suggestion that can be made is that all cylinders should be provided with cleaning-doors, to give ready access to every part, and that ample provision for cooling should be made. The cooling tanks supplied are often inadequate. Nearly all the breakdowns attributed to connecting-rods resulted from fractures of the bolts in the big ends. These bolts, in the majority of cases, are undoubtedly too weak.

Many gas-engine crank-shafts also fail from weakness, others from carelessness in adjusting the bearings, and in keeping them in alignment where there are more than two; and some—probably not very many—from brittleness of the material. Of the shafts that broke during 1905, 50 per cent. had two bearings, and 50 per cent. more than two. As regards fly-wheels, 33 per cent. had two, and 67 per cent. one. Of the shafts with two bearings, 22 per cent. broke in the crank-arm next the fly-wheel, 23 per cent. in the crank-pin, and 55 per cent. in the neck between the crank and the fly-wheel. Of those with more than two bearings, 78 per cent. broke in the neck between the crank and the fly-wheel, and 22 per cent. in the crank-arm next the fly-wheel. As a very large proportion—probably something like 75 per cent. of the gas-engines insured—have only two bearings, the figures show that the third bearing plays no small part in the destruction of the gas-engine shaft. The same remark may be made with regard to single fly-wheels. The principal resistance to the motion of the gas-engine piston is due to the inertia of the fly-wheel, and consequently the stress on the shaft is due principally to the fly-wheel. If therefore the necessary weight be divided equally between two fly-wheels, one on each side of the crank, the intensity of the stress upon the shaft is halved. The fly-wheels of gas-engines should be very carefully balanced, especially if they are overhung. Otherwise their oscillations may bring heavy stresses upon the crank-pins. It may be noted that the crank-pins which broke belonged to engines with two overhung fly-wheels.

Examples of breakdown of valves and valve gears, cylinders and cylinder ends, and connecting rods and shafts are given by Mr. Longridge, as well as descriptions of some miscellaneous breakdowns:—

1.—Horizontal gas-engine, with cylinder 10 inches diameter by 19-inch stroke, running at 190 revolutions per minute, with producer gas from a suction plant. When attempting to start the engine one Monday morning, the cast-iron lever for working the air-admission valve broke near the fulcrum. There was no doubt about the cause. The valve was stuck fast by rust produced by moisture or by tar, or both, deposited from the gas during the previous week.

Tar is often a serious cause of trouble with gas-engines, not only necessitating overtime for taking out the valves and cleaning them, but sometimes leading to racing by keeping the gas-valve open, and thus liberating the engine from the control of the governor.

2.—Horizontal Otto-cycle gas-engine, with cylinders 16 inches diameter by 20-inch stroke, running at 160 revolutions per minute. The bevel wheels for driving the governor broke, and were replaced by a new pair, which also broke after running for a month. The cause of the damage was end movement of the side-shaft which carried one of the wheels. After the slackness had been taken up the wheels gave no further trouble.

3.—Horizontal gas-engine, with cylinder 20 inches diameter by 24-inch stroke, running at 160 revolutions per minute, with gas from the town main. The engine was started in 1904. In July, 1905, the cylinder end cracked, and was replaced by a new one of the same design. In November, the new end cracked. The Company then declined to renew the insurance except at an increased premium, or excluding liability to replace the cylinder ends. The owner accepted the latter alternative. A few months later, a new end of slightly different design was put in. About six months later, this end cracked, and has since been replaced. Clearly the design was unsuitable for the high pressure and temperature to which it was exposed.

4.—Horizontal gas-engine, with cylinder 11 inches diameter by 20-inch stroke, running at 180 revolutions per minute, with gas from a town main. After working for five years, the cylinder end cracked, both on the outside surface and through the partition, separating the water-jacket from the combustion chamber; so that the water from the jacket ran into the cylinder. When the casting was broken up, the jacket was found nearly full of lime. No cleaning-door had been provided.

5.—Horizontal gas-engine, four years old, with cylinder 12 inches diameter by 22-inch stroke, running at 220 revolutions per minute, with town gas. One afternoon the engine suddenly broke down. The cylinder, bed-plate, piston, cylinder jacket, and fly-wheel were all broken, and the connecting-rod bent. The accident was due to the failure of the bolts in the big end of the connecting-rod. This was of the marine type; the cap being secured by two 1-inch bolts. One of these had evidently been partly fractured for some time; and it no doubt gave way first.

6.—Horizontal gas-engine, with cylinder 14 inches diameter by 21-inch stroke, running at 200 revolutions per minute. One afternoon the bolts in the big end of the connecting-rod gave way; and the engine was completely wrecked, except the crank-shaft and fly-wheel. In this case, the bolts were $1\frac{1}{8}$ inches diameter.

These two cases are typical of many others, and support the opinion so often expressed by Mr. Longridge that the bolts in the connecting-rods of gas-engines are, speaking generally, too weak. It is said that these bolts have nothing to do, as the connecting-rods of gas-engines are always in compression. This, Mr. Longridge holds, is not the case. During the charging-stroke, the bolts have to pull the piston forward; and the pull required to do this is not entirely negligible. Assuming the weight of the moving parts as equal to a pressure of $3\frac{1}{2}$ lbs. per square inch of piston area, which is a fair average for engines of the sizes described, the forces required to impart their velocities to the pistons in the two cases must have been 6000 and 6400 lbs., and the stresses on the bolts at the bottoms of the threads 5100 lbs. and 4570 lbs. per square inch respectively. When it is remembered that these bolts are subject to shock whenever the brasses are at all slack, and also in many cases to bending stresses, and that over and above these, which may be called the ordinary working stresses, there are the possibilities of pistons seizing, it seems clear that stronger bolts than are usually fitted are required, or that the marine end should be discarded in favour of one of the systems adopted by locomotive engineers.

7.—Horizontal gas-engine, with cylinder 16 inches diameter by 22-inch stroke, running with producer gas at a speed of 160 revolutions per minute. Noticing a slight wobble in one of the fly-wheels, the attendant stopped the engine, and found the crank-pin broken through close to one of the cranks. The maximum pressure on the piston not known—it probably varied from 50,000 lbs. to 70,000 lbs., of which about 10,000 lbs. would be absorbed by the piston and connecting-rod, leaving from 40,000 lbs. to 60,000 lbs. to be carried by the crank-pin. The pin was 6 inches diameter by $6\frac{3}{4}$ inches long, and the distance from centre to centre of the shaft-bearings, which were 12 inches long, was 34 inches. The cause of the breakage was weakness. The shaft had been running about 140 hours per week for about six months when it broke. The engine is said to have made about 68 explosions per minute in ordinary work. At this rate, the life of the shaft must have been only about 230,000 explosions and 537,000 revolutions.

8.—Horizontal gas-engine, with cylinder 17 inches diameter by 24-inch stroke, running at 216 revolutions per minute, with producer gas. The crank-shaft was carried in four bearings: No. 1, 6 inches diameter; Nos. 2 and 3 on either side of the crank, each $6\frac{3}{4}$ inches diameter and 12 inches long; and No. 4, $4\frac{3}{8}$ inches diameter. The fly-wheel, weighing about $7\frac{1}{2}$ tons, was carried between Nos. 1 and 2; and the rope drum, 4ft. 8in. diameter by $18\frac{1}{2}$in. wide, between Nos. 3 and 4. Nos. 2 and 3 bearings were formed in the engine-bed; Nos. 1 and 4 were carried on independent stools standing on the same foundation as the engine. This foundation was of concrete. The engine-bed and stools were set on packings about $2\frac{1}{2}$ inches above the concrete; and the space between grouted with cement. An even floor was then made by covering the concrete, packing, grouting, and lower edge of the bed-plate with a mixture of sand and cement. The crank-shaft broke one morning through No. 2 neck close to the web of the crank, breaking the bottom brass, and ring-oiler, and damaging the top brass. The cause of the damage was settlement of the engine-bed, owing to the wear of the packings on which it stood. These, instead of being solid pieces of iron properly prepared for the purpose, were made up of numbers of small pieces of wrought-iron, cast-iron, and hoop-iron—in fact, anything that was handy when the engine was put down—laid side by side and one upon the other, and had ground one another and the concrete on which they stood. When the new shaft was put in place, it was found that No. 1 bearing was $\frac{1}{4}$ inch and No. 4 $\frac{1}{8}$ inch too high. This led to an examination of the foundation, and to the discovery of the cause of damage. During the three months the engine had run, it had been necessary to tighten the holding-down bolts at the crank-end of the bed-plate frequently, and also to scrape the brasses in the two outer bearings.

The plan of placing engine bed-plates on packings or wedges, and grouting them, is (Mr. Longridge observes), as generally carried out, far from satisfactory or permanent. Oil from the bearings softens the concrete; and the excessive pressure per square inch between the packings and the concrete causes attrition of the latter. If the packings are to be relied on to support the engine, they should be in the form of folding wedges of large bearing surfaces, with slots from one edge of each to the centre to allow the holding-down bolts to pass through them when in place. If the concrete is relied on, then the bearing surfaces on the underside of the bed-plate should be large and broad; and proper provision, by way of channels round the feet and otherwise, should be made to keep oil and oily water from the concrete. With this system, the wedges are only required to set the bed-plate level before the cement is run under it; and the bed-plate is screwed down not on them, but on the cement in the same way as a bed-plate which has been rubbed down on a dressed ashlar seat.

9.—Horizontal Otto-cycle gas engine, two years old, with cylinder 11 inches diameter by $18\frac{1}{2}$-inch stroke, running at 176 revolutions per minute. One morning, soon after the engine had started, the cylinder jacket parted circumferentially, about the middle of its length with a loud report. The back end containing the valves was forced backwards about 3 inches, carrying the liner with it, and breaking the bracket which carried the governor and the bearing for the side shaft.

No cause could be definitely assigned for the fracture; the only defect proved being the exceeding brittleness of the metal which, though ⅛ inch thick, was easily broken with a hand hammer. The engine was fed with town gas giving an explosive pressure of about 400 lbs. per square inch in the cylinder, or a load of about 38,000 lbs. per square inch. The cross-sectional area of the fracture was 45 square inches; and the stress consequently only 845 lbs. per square inch.

10.—Horizontal gas-engine, with cylinder 14 inches diameter by 22-inch stroke, running at 165 revolutions per minute. The exhaust-pipe was broken at a bend below the cylinder. The cause of the breakage was stress produced by the expansion of the pipe, which was rigidly held in concrete beyond the bend. In another case the exhaust-pipe broke close to the cylinder from the same cause owing to the silencer at the end of it being jammed against a wall in a corner. Breakages of this kind are by no means infrequent, and indicate that provision for expansion by rise of temperature should always be made.

11.—Horizontal 120 brake horse power gas-engine, with cylinder 20 inches diameter by 30-inch stroke, running at 160 revolutions per minute. The crank-shaft carried two cast-iron fly-wheels 9 feet diameter, each having six curved arms and a rim 15 inches broad by 8½ inches deep. In order to ascertain whether the engine was giving the power guaranteed, a brake was fitted to one of the fly-wheels without any provision for keeping the rim cool, and the engine run at full load. In a little while, the rim began to get very hot; and the engine was slowed down to cool it. After running for about two hours in this way, the load was again put on; and about ten minutes later the wheel burst with a loud report. Fortunately no one was hurt.

Mr. Longridge has been told that it is quite a common thing to put brakes on the fly-wheels of gas-engines without any provision for taking away the heat generated. It seems to him a risky proceeding. In this case, the heat generated was 5120 B.Th.U. per minute, enough to raise the temperature of the entire rim 4½° Fahr. per minute, and the external surface thereof considerably more. The danger of heating the outer circumference of a casting 9 feet diameter of very unequal thickness, and with no provision for expansion beyond the curvature of the arms, appears to have been much under-estimated.

12.—Horizontal gas-engine, with cylinder 7 inches diameter by 14-inch stroke, running at 224 revolutions per minute with gas from the town main. The engine was set to work in April, 1904. One day in July it refused to start. On the engine being taken to pieces, one of the piston rings was found to be broken, and the remaining rings somewhat worn, but not enough to prevent the engine starting. Finally, it was discovered that the exhaust-pipe between the cylinder and the silencer was almost completely choked with deposit. After it had been cleaned out, the engine started, and ran satisfactorily, with the exception of a slight escape of gas past the piston, which was stopped by a new set of piston rings.

The choking of exhaust-pipes is not uncommon with producer gas; but that it should have occurred with town gas after the engine had been running so short a time, is strange.

The report throughout is illuminating; and, among other things, it shows, without the point being obtruded on the reader, the value of inspections by the experts of a Company who are accustomed to meeting with trouble in motive power plant in all its variety of forms, and, being so accustomed, know where to look for possible trouble, and to advise as to preventives.

The Operation of the Prevention of Corruption Act.—Notwithstanding the extent to which the defunct Education Bill has "bulked," as our friends north of the Tweed say, in general conversation, we doubt whether it has been so much talked about in commercial circles as the Prevention of Corruption Act, more especially with regard to the retrospective action of the latter measure. In the "JOURNAL" for the 11th inst., we quoted the opinion of Mr. T. A. Nelham, as expressed in a little handbook published by Messrs. Sweet and Maxwell, to the effect that the Act will be retrospective. This dictum of a lawyer was challenged in our columns last week by a correspondent who is "Not a Lawyer;" and it seems that his view is the correct one, for the Attorney-General, in a letter to the Secretary of the Furnishers' Chamber of Trade, has stated that the Act is not retrospective. A similar opinion has, we believe, been given by a very eminent Counsel.

Starting the Astoria Gas-Works, New York.—Our readers may remember that about two years ago we gave an illustrated description of the extensive works which were being erected at Astoria, by the Consolidated Gas Company, for the supply of gas to New York. We learn from the last "American Gaslight Journal" to hand that gas making was commenced in retort-houses Nos. 1 and 2 early this month, and the gas sent to Manhattan by way of the Ravenswood tunnel. Our contemporary says the starting took place without a hitch, and "everything worked to a charm." The Company's Chief Engineer, Mr. W. H. Bradley, and his staff are to be heartily congratulated on the successful inauguration of the first section of gas-works which, when completed, will probably be the largest in the world. There was no formal "opening;" the first firing-up of the plant being witnessed by only a few persons. We learn from our contemporary that, in connection with the event, an announcement was made that an arrangement had been perfected under which the wages of all the employees of the Company amounting to less than $2000 per annum have been increased by 10 per cent. As far as we can gather, this was a purely voluntary act on the part of the Company, and was not the result of any agitation by the employees.

THE DERBY TRIALS OF SUCTION-GAS PLANTS.

In the last number of the "JOURNAL," we notified the issue of the report on the trials of suction-gas plant carried out by the Royal Agricultural Society of England at Derby in June. It was drawn up by Captain H. Riall Sankey, R.E. (retired), M.Inst.C.E., who was one of the Judges; his colleague being Professor W. E. Dalby, M.A., B.Sc., M.Inst.C.E. The object of the trials, which have aroused considerable interest, was to determine, so far as a series of tests extending over one week would permit, whether plants producing suction gas for driving motors could be relied upon to work continuously for agricultural purposes with the same freedom from breakdown as steam-engines, and with the small amount of attendance required by oil-engines. When the decision of the Society to conduct the trials was made known, the response of the makers of plants was beyond expectation. Fourteen were entered for the competition; but three were withdrawn during the progress of the tests. The size of the plant fixed upon was from 15 to 20 B.H.P.; this being suitable for threshing and many other agricultural purposes. Captain Sankey states that one of the most important points in judging the merits of the various plants was the fact that these combinations of producers and engines would, in many cases, be placed in the hands of agricultural labourers, to whom very little discretion could be given in mechanical matters; and therefore means of adjustment intended to obtain small economical advantages would not be of the same value as when in the hands of skilled attendants.

These preliminary remarks are followed by the regulations issued by the Society in regard to the trials; and intending competitors were informed that the points to which special attention would be directed were: (1) The attendance necessary; (2) the general design of the plant, including facility of cleaning and space occupied; (3) regularity of working; (4) fuel and water consumption; (5) price; (6) relative proportions of gas producer and engine; and (7) volume swept by piston relative to the brake-horse-power. A few remarks are made upon the regulations, in order to indicate the general considerations guiding the Judges in their inquiries and observations during the trials and in making their awards. Dealing first with the attendance necessary, it is pointed out that an important distinction must be drawn between that required for starting the plant and that needed for looking after it when running; the latter being thus in a measure dependent on the regularity of the working or the reliability of the plant. Passing on to the subject of general design, Captain Sankey says "a simple straightforward design is the *desideratum*." The design of the plant in respect of provision against possible escape of poisonous gas or risk of explosion required careful consideration. The regularity of running, when coke is the fuel, depends on the quantity of tar deposited on the valve-seats; and at present no adequate provision can be made in the producer for preventing the formation of tar, if the coke contains it in any material quantity. It is pointed out that gas coke varies considerably in regard to its freedom from tar; and Captain Sankey says it is to be hoped that "when suction-gas plants become more general, an arrangement will be made whereby some standard of permissible percentage of tar can be ensured."

After a few observations on regularity of working, the subject of fuel consumption is taken up. It is remarked that, owing to the conditions of running of these plants, it is important to know the consumption of fuel, including the quantity burnt at night when the plant is standing. The general practice, in the case of an engine doing constant work, is to light the fire on Monday morning, bank it during the night, and only draw it on Saturday to clean out the producer. This practice was kept in mind in arranging the trials. Captain Sankey points out that, though anthracite can be obtained in most districts, it is easier to get coke; and, apart from the difficulty already referred to in connection with tar, it will generally prove to be a cheaper fuel, notwithstanding the greater weight consumed. The coke trial was therefore of special importance. It was borne in mind that, in the case of these plants, "the cost of coal is relatively far less important than in the case of a steam-engine, because in the former from 1 lb. to 1½ lbs. of coal or coke is required per B.H.P.-hour; whereas in the case of non-condensing steam-engines of a suitable class for 'estate' engines, from 5 lbs. to 6 lbs. are needed, and about 3 lbs. with small condensing engines." The Society thought the regulations covered all the essential points for consideration in the trials. In the succeeding portion of the report, Captain Sankey gives a few historical notes on suction-gas plants combined with gas-engines, taken from a paper read by Mr. W. A. Tookey before the Junior Institution of Engineers earlier in the year, and noticed in the "JOURNAL" at the time.* He then explains the design and construction of these plants—giving illustrations of those of the National Gas-Engine Company, Limited, and Messrs. Crossley Bros., Limited; and he follows this up with a description of the gas-engines used.

The trials were started at 9 a.m. on Monday, the 18th of June, and began with full-load trials, using anthracite as a fuel. The producers were empty, and the time of starting each engine and getting on the full load from the moment of laying the fire was noted. The various plants were started at intervals, and each was run for nine hours on full load and then stopped. The

* See "JOURNAL," Vol. XCIV., p. 236.

TABLE I.—*Particulars of Full Load Trial with Anthracite.*

Name of Plant.	Total Hours Running on Full Load. Banked 14 Hours.	Net Coal Used.	Coal per Hour of Running Time.	Total Water Used.	Water per Hour.	Average Load on Brake.	Average Revs. per Min.	Brake Constant.	Average B.H.P.	Coal per B.H.P. per Hour.	Water per B.H.P. per Hour.	Per Cent. of declared Full Load.	Per Cent. of Catalogue Full Load.
		Lbs.	Lbs.	Gallons.	Gallons.					Lbs.	Gallons.		
National	14 02	303	21·6	329	23·5	192·5	191·8	·000558	20·6	1·04	1·14	103·0	103·0
Railway and General	14·00	416	29·7	1012	72·3	220·0	170·5	·000533	20·0	1·48	3·61	100·0	100·0
Davey-Paxman	14·00	295	21·1	248	17·7	149·4	226·1	·000484	16·4	1·28	1·08	106·0	106·0
Dowson	14·08	312	22·2	264	20·0	189·4	192·4	·000559	20·4	1·09	0·98	102·0	102·0
Campbell	13·70	289	21·1	324	23·6	245·5	201·8	·000390	19·3	1·09	1 22	107·0	107·0
Campbell (throttle)	14·00	336	24·0	393	29·6	290·6	188·8	·000389	21·4	1·12	1·38	107·0	107·0
Dudbridge	14·00	321	22·9	602	43·0	207·2	193·4	·000389	15·5	1·47	2·76	77·5	77·5
Mersey	13·93	307	22·0	668	48·3	280·0	203·5	·000343	19·5	1·13	2·47	97·5	97·5
Kynoch	14·00	297	21·2	180	13·4	115·2	240·0	·000668	18·4	1·15	0·73	108·0	108·0
Newton	14·05	*	..	709	50·4	193·0	192·5	·000487	18·1	..	2·80	..	90·0
Fielding	14·00	338	24·1	516	36·8	174·4	318·5	·000484	18·4	1·31	2·00	102·0	92·0
Crossley	14·00	247	17·6	517	37·6	195·3	178·7	·000439	15·3	1·15	2·45	102·0	102·0

* Fuel returned from producer not weighed.

TABLE II.—*Particulars of Half Load Trial with Anthracite.*

Name of Plant.	Total Hours Running on Full Load.	Net Coal Used.	Coal per Hour.	Total Water Used.	Water per Hour.	Average Load on Brake.	Average Revs. per Min.	Brake Constan .	Average B.H.P.	Coal per B.H.P. per Hour.	Water per B.H.P. per Hour.	Per Cent. of Declared Full Load.	Consumption of Coal Adjusted to 50 per Cent. of Declared Full Load.
		Lbs.	Lbs.	Gallons	Gallons.					Lbs.	Lbs.		Lbs.
National	6·00	94	15·7	31	5·17	93·7	193·6	·000558	10·1	1·55	0·52	50·5	1 55
Railway and General	6·00	109	18·2	112	18·67	111·5	173·2	·000533	10·3	1·77	1·81	51·5	1·78
Davey-Paxman	6·00	97	16·2	52	8·67	72·8	231·6	·000484	8·2	1·98	1·06	53·0	2 06
Dowson	6·00	92	15·3	41	6·83	95·5	194·9	·000559	10·3	1·49	0·66	51·5	1·51
Campbell	6·00	88	14·6	88	14·67	134·3	202·0	·000390	10·6	1·38	1·39	59·0	1·50
Campbell (throttle)	6·00	100	16·7	121	20·17	153·5	195·3	·000389	11·7	1·43	1·72	58·6	1·54
Dudbridge	6·00	110	18·3	120	20·00	121·4	197·2	·000389	9·3	1·97	2·15	46·5	1·89
Mersey	6·00	114	19·0	200	33·33	138·0	206·3	·000343	9·8	1·95	3·42	49·0	1·91
Kynoch	6·00	99	16·6	21	3·50	60·4	240·6	·000668	9·7	1·71	3·61	57·0	1·88
Newton	5·00	..	..	124	24·80	101·0	196·3	·000487	9·6	..	2·58	48·0	..
Fielding	6·00	106	17·7	133	21·17	85·9	222·0	·000484	9·2	1·92	2·41	51·0	1·95
Crossley	6·02	77	12·8	45	7·47	105·2	181 3	·000439	8·4	1·52	0·89	56·0	1·62

TABLE III.—*Particulars of Full Load Trial with Coke.*

Name of Plant.	Total Hours Run on Full Load.	Net Coke Used.	Coke per Hour.	Total Water Used.	Water per Hour.	Average Load on Brake.	Average Revs. per Min.	Brake Constant.	Average B.H.P.	Coke per B.H.P. per Hour.	Water per B.H.P. per Hour.	Per Cent. of Declared Full Load.	Per Cent. of Catalogue Full Load.
		Lbs.	Lbs.	Gallons.	Gallons.	Lbs.				Lbs.	Gallons.		
National	9·00	224	24·8	258	28·7	191·9	190·8	·000558	20·5	1·21	1·40	102·0	102·0
Railway and General	9 00	255	28·3	710	78·9	207·5	183·1	·000533	20·2	1·40	3·90	101·0	101·0
Davey-Paxman	9·00	199	22·1	191	21·2	120·4	231·4	·000484	13·4	1·64	1·58	86·5	86·5
Dowson	9·00	232	25·8	320	35·6	193·3	188·8	·000559	20·4	1·26	1·75	102·0	102·0
Campbell	9·00	203	22·6	440	38·9	203·8	201·3	·000390	17·0	1·33	2·28	100·0	94·5
Campbell (throttle)	9·00	214	23·7	330	36·7	231·3	190·5	·000389	17·1	1·39	2·12	95·0	85·5
Dudbridge	7·33	189	25·7	517	70·5	206·7	194·1	·000389	15·6	1·65	4·52	78·0	78·0
Mersey	9·00	213	23·7	875	97·2	240·0	205·5	·000343	16·9	1·40	5 70	84·5	84·5
Kynoch	9·00	222	24·7	284	31·6	112·3	240·4	·000668	18·0	1·37	1·75	106·0	103·0
Fielding	9·00	250	27 8	440	38·9	176·4	221·0	·000484	18·8	1·48	2·06	104·5	94·0
Crossley	9·00	170	18·9	720	80·0	174·2	181·6	·000439	13·9	1·36	5·76	107·0	93·0

hopper and the fire-doors of every producer were then sealed up. The last engine was stopped at about 7 p.m. During the night the fires were banked. Next morning, the first plant started on the previous day was got under way, and the time required before the engine could be started and the full load put on was noted. The other plants were successively started in the same manner, so that in each case the fires were banked for approximately fourteen hours. The full load was maintained for five hours, after which the engines were stopped, the fires drawn, and the partially consumed fuel placed in iron vessels for weighing and examination. This completed the full-load anthracite trials, which consisted of nine hours full load, fourteen hours banked fires, and five hours full load. The half-load trial was carried out on Wednesday, June 20; the variable load trial next day; while the full-load coke trial was made on Friday. In all the trials the engines and producers were entirely in the hands of the exhibitors' representatives; and so long as the load was maintained within a 5 per cent. limit during the time specified, they were at liberty to make any adjustments they desired.

The coal used was Western Valleys anthracite, and was of the size known as "beans." This coal was chosen because it is well known, and easily obtained of uniform quality. It contained 3·22 per cent. of moisture, and 6·44 per cent. of ash; the effective heat value, determined by combustion by oxygen under pressure, being 7·475 calories per gramme. The hydrogen only amounted to 2·7 per cent. The coke was supplied by the Derby Gas Company, and was selected as free from tar as possible, and picked to a uniform size of 3 inches; but the competitors were allowed to break it to any size they pleased.

In the course of his remarks on the plants, Captain Sankey deals with the chances of explosion and the escape of poisonous gas. Careful examination showed that, except from carelessness on the part of the attendant, the risks of a harmful explosion occurring are practically *nil*. As to poisoning, since the gas produced contains a large amount of carbonic oxide, this matter was very fully considered. When the engine is working, the pressure in the producer is below that of the atmosphere; and therefore any leakage would be into the producer. Consequently, it is when this is being started, or opened up after running, that there is any real danger of poisoning; but the reporter says "an accident could only happen through gross carelessness." There did not appear to be any serious fire risk with any of the producers tried—no more, in fact, than with a slow-combustion stove.

The report is accompanied by a number of tables giving the results of the trials. Of these we reproduce three. With reference to them, Captain Sankey says that, notwithstanding the difficulties in making consumption tests, owing to the large stopping and starting errors, the consumption of many of the engines came out almost the same. Moreover, those engines which had a comparatively low ratio of compression gave the highest consumption, as might have been expected *à priori*; but, judging from the trials, beyond a certain ratio of compression no advantage is gained as regards consumption, as appears by comparing in Table I. the coal consumption of the National, Campbell "hit-and-miss," and Crossley plants. The ratio of compression in the Crossley engine was considerably higher than in the two former engines. It will be noticed that most of the engines worked slightly above the "declared" and the "catalogue" full load; and only in one case was the load seriously less. The amount of water required per B.H.P.-hour varied enormously, and it would appear that in many cases it was not regulated with the care that might have been expected.

The first point to observe in Table II. is that in several cases the engines did not work exactly at 50 per cent. of the "declared" full load (see last column but one). An adjustment was therefore made by means of the Willans law (see last column), in order to obtain the consumption of coal at exactly 50 per cent. of the "declared" full load. On comparing Tables I. and II., it will be noticed that the plants are practically in the same order of merit. Again, the water per B.H.P.-hour varies very considerably.

With reference to Table III., which gives the particulars of the full-load trial with coke, Captain Sankey points out that there is considerable uniformity in the consumption figures, and that the order of merit is nearly the same as in the anthracite trials. The most noticeable feature, however, is that only four of the engines worked above the "catalogue" full load, and that many of them worked at considerably lower power. Even in the case of the "declared" full load, four of the engines were unable to reach the power anticipated (as shown by the figures in the last column but one). It is thus clear that coke is generally found to be a more difficult fuel to deal with in suction producers than anthracite. As in the previous trials, there is considerable difference in the quantity of water used per B.H.P.-hour; and, on comparing the figures with those in Table I., it will be found that it is generally greater than in the case of anthracite.

Captain Sankey says it can be deduced from the trials that the following fuel and water consumptions may be expected with a good suction gas-producer plant when working continuously at the loads specified and under the best conditions:—

Anthracite.

Full Load.—1·1 lbs. per B.H.P.-hour, including fuel needed for starting and for banking during the night.

Half Load.—1·6 lbs. per B.H.P.-hour, including coal for starting.

Water.—1 gallon per B.H.P.-hour at full load, and ¾ gallon at half load.

Coke.

Full Load.—1·3 lbs. per B.H.P.-hour, including fuel needed for starting.

Water.—1½ gallons per B.H.P.-hour at full load.

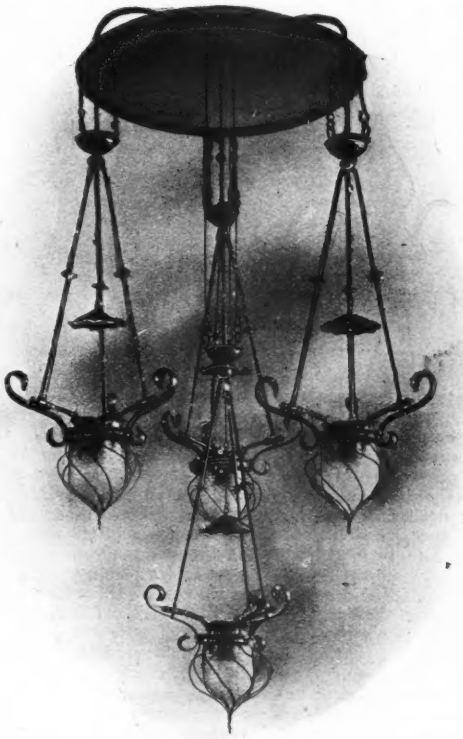
In the course of his general conclusions, Captain Sankey says it is evident, from the results of the trials, that many of the suction gas-producer plants submitted were quite satisfactory. Although, however, less manual labour is required than in the case of a steam-engine, more intelligent care is necessary to ensure the production of gas of good quality. The economy trials confirm the results that have been previously obtained elsewhere, when the fuel required for banking and starting is taken into account. In reference to the attendance, it is less than would be necessary for a steam-engine and boiler, and not appreciably greater than what is needed by an oil-engine of the same power under like circumstances. As regards reliability, the duration of the trials was insufficient to warrant a definite opinion; and only actual experience can show to what extent "clinkering" and "staging" of the fuel may be sources of trouble in the conditions under which suction-gas plants may have to run for agricultural purposes. Captain Sankey says it is probable that these plants will be able to replace portable steam-engines for many purposes with distinct advantages, both as regards handiness and economy. He considers that a further step in advance will be made when a traction suction-gas plant has been placed on the market. Another *desideratum* is a suction producer which will deal satisfactorily with bituminous coal. It is understood that several firms are experimenting with such plants, that successful results have already been obtained, and that at no distant date it may be possible to hold competitive trials.

NEW "ECLIPTIC" GAS-FITTINGS.

Efficiency and excellence of appearance are the most certain qualities in any article to promote commercial success; and commercial success means largeness of demand. The largeness of demand upon the "Ecliptic" fitting department of the Nuneaton Gas Company has compelled the making of arrangements for a new Company (in which the Gas Company retain a financial interest) to work this branch, and to give greater facilities for negotiating and dealing with business. To this latter end, a show-room and warehouse have been taken at No. 19, Farringdon Street, E.C.; and there may now be seen examples of the numerous fittings made by the Company, and grouped under the above-mentioned trade name. We have been to the show-room, have seen, and are satisfied that there there is assembled, under

The "Palace Burner."

35 patents (Helps') and numerous registered designs, much in the way of novelty and originality, all tending to gratify the eye, to realize high points of duty from the gas consumed, and to maintain the efficiency. That is what the consumer of gas for lighting—his tastes having been refined and his requirements raised—of the present day requests. There is not a form of lighting for (say) from cathedrals down to the humblest room, for which the new "Ecliptic" Gas-Light Company cannot offer suitable fittings, with their special inverted burners and glassware. The features peculiar to the burners and lamps are many; but the removable plug, in which is the adjustable nipple, is the principal feature in the maintenance of a high efficiency. This plug can be taken out by hand, blown out by the consumer, and replaced in two or three seconds, so that the saving of labour is great, especially in maintenance work. It is a case of facility lending great aid to the constancy of efficiency. There are combination fittings, too, with these removable plugs to each burner or with a single central one supplying the whole of the burners. Circumstances vary results; but it may be taken as a general measure of duty where conditions are favourable that 30-candle power per cubic foot of gas consumed may be calculated upon.

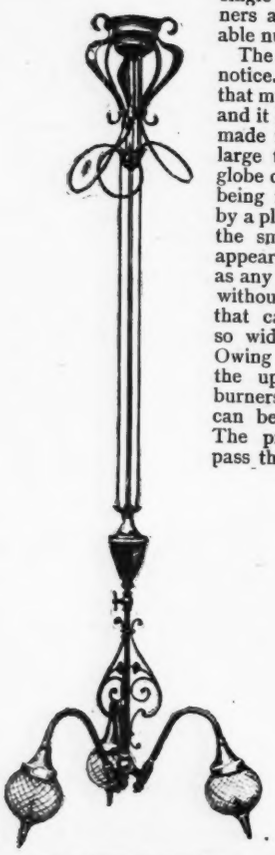


The "Bishop" Light.

With regard to the metal work of the fittings, choice design is accompanied by excellent and solid workmanship. This not only applies to one fitting, but to the whole; it being an axiom of the Nuneaton factory (where manufacturing operations will still be carried on) that what is "worth doing at all is worth doing well," and on that the reputation of these fittings is based.

A brief reference may be made to some of the new designs seen

in the show-room. Nothing but admiration can be expressed for the "Bishop" light—a design taken from an old lamp in the Madrid Cathedral. The lamps are clustered in four, and each one is suspended from a separate ornamental support—the burners giving an illuminating power of 100 candles each. They can be arranged to rise and fall. An important feature of these lamps, in view of their suspension over the heads of people, is the fine wire guards, spirally constructed, outside the globes, so that, in the event of breakage, no pieces of glass can fall. These guards, instead of being in any way unsightly, give additional character to the fitting. The products of combustion pass away quite clear of the overhanging tubes; and although flexible tubing is partially used, and acts as an anti-vibrator, the fittings are not supported by it, but by chains. We find, indeed, with many of the Company's new fittings other than brackets that, while flexible metallic tubing has a part in their design, it is more sparingly used than formerly. We see this in the "Seguro" rise-and-fall pendant. The down rod is of brass; and the fitting is supported by chains—a modest amount of flexible tubing at the top being merely employed for the twofold purpose of acting as a gas-way and anti-vibrator. These pendants are made to carry any design of the "Ecliptic" burner—one, two, three, or more. In fact, after single ones, the combinations of burners are from two up to any reasonable number—say, 25.



The "Seguro" Pendant. (Closed.)

The "Palace" type of burner attracts notice. It is made for a range of utility that must command every requirement; and it has several novel features. It is made in large and small types—in the large types to carry within the single globe one or more mantles (the mantles being neatly and accurately supported by a plate fixed by a bayonet joint); and the smaller forms have as much the appearance of the Nernst electric lamp as any gas-burner we have ever seen, but without any of the complicated structure that causes the Nernst lamps to be so widely and frequently condemned. Owing to the peculiar construction of the upper part of these "Palace" burners, it is impossible to see how there can be any discoloration of ceilings. The products of combustion have to pass through the highly-heated chamber at the top, so that no unconsumed carbon can possibly escape into the atmosphere of the room without first being destroyed. Besides this, the products of combustion pass away through numerous downward exits, so that they are split up and dissipated, preventing any direct upward current. These burners are absolutely air and dust proof; and tested by subjecting them to violent draughts, there was not the slightest flickering of the light. The same burners with opal globes (there are no openings by the way in these globes, the secondary air supply being all taken in above) gives a soft and most pleasant light to work by. Clustered on gracefully curved arms, either closely grouped or expanding, the burners are very effective. The same may be said of the "Ring Floss" cluster of bijou burners.

The "Ring Floss" Cluster.

Coming to the brackets, there are handsome fittings on view, and equally handsome arrangements for converting ordinary fittings for inverted burners. The Company are making a feature of two-light brackets; but there is no occasion to stay at two lights—other fittings with three and more spreading or closely grouped drops, being very much to one's fancy. Another point to notice is a patent for supporting globes. In this instance, globes are supported by a small ornamental bottom cup carried by a couple of wires within the globe. When the globe and support are in position, all that has to be done is to screw up a nut at the bottom. The wires prevent any over-tightening of the nut to the detriment of the globe; and the wires also prevent the globe, when being taken off or replaced, doing injury to the mantle.

The "Ecliptic" business continues under the management of Mr. John Reid, who was for some years Engineer to the Céara Gas Company.

LONDON AND SOUTHERN JUNIOR ASSOCIATION.

The December Meeting of the Association was held last Wednesday in the Small Hall of the Cripplegate Institute, under the presidency of Mr. W. Upton.

Mr. L. F. Tooth (of the Commercial Gas Company) read a paper entitled—

LIGHTING AND MAINTENANCE.

The following are some extracts from the paper, which was somewhat lengthy, but of a very practical character.

I propose to consider the duty of a lighting and maintenance department, with its object of retaining the business we already have; the possibilities of extension and the training of the necessary staff to carry out any such extension; and the purchase of material to the mutual advantage of company and consumer, which I consider is as important as the sale. To obtain these results in face of competition—especially municipal—one must not expect to commence and discharge his duties at the appointed times of his company, and carry them on as a matter of ease, but must keep himself abreast with current events, and be at his post at all hours. The staff should be well advised on the question of the comparative cost of gas and electricity, and their advantages and disadvantages.

Every possible facility should be given to men to educate themselves in their business. By so doing I find they take a keener interest, and are always ready to do their best to master their work and keep themselves up-to-date with the latest ideas and methods. They should be provided with written instructions, and each individual system should be dissected and demonstrated. The methods of adjustment should be described, and the colour of flames. They should be taken through the whole routine of each system, with its possible defects and remedies, and given hints how to treat a customer should he turn disagreeable.

One has to be very careful in buying, and also as to what class of article he adopts. I find that it is very necessary to buy largely, in order to give the consumer a cheap article and leave a margin for profit. You not only have the opportunity of buying cheaply, but you always have a stock for immediate use. When taking up a new article, care should be exercised to ensure that it will give the consumer the best return, and that the renewal parts can be obtained, especially those of foreign manufacture. Makers and factors should be urged to make and stock all parts to a standard thread and gauge; and until they recognize this, we shall never get a satisfactory result. For instance, there are dozens of different makes of "C" burners which are not interchangeable, and which not only cause confusion in the maintenance department, but are very annoying to consumers. Makers cannot be complimented upon the way that they are handling the inverted burner. There are at least a dozen different makes which require special mantles, and have some supposed improvement to foil the use of a universal standard mantle fitting. Unless something is done to bring about a standard for these burners, the grave defect I have alluded to must necessarily retard their adoption.

Every endeavour should be made as far as possible to adopt English goods, because if you depend upon the foreigner, and his business is taking him in another direction, you have to wait. Just lately, we have been handicapped for the supply of glass for over six weeks, owing to a strike in Hamburg; and I consider that the sooner the English manufacturers direct their attention to glass making at anything like a reasonable figure, the better it will be. English brass goods are easily obtainable at prices competing well with foreign—giving better results, and a more substantially made article. Cheap German-made fittings, burners, and mantles do more harm to the gas industry than it is possible to conceive.

The most important factor in gas-lighting to-day is a uniform and increased pressure. I find that burners working under pressures of 3 inches and over give vastly better results in every way than under the old 15-10ths conditions. Pipes can be reduced to half the size of those required for very low pressures; complaints of bad lights and stopped supplies are reduced to a minimum; the nipples will not get choked with dust so quickly; the mantle has more chance of adapting itself to the flame, and *vice versâ;* and increased pressure prolongs the life of the mantle, as it becomes hardened and crisp after being burnt for a short time.

In order to give the candle efficiency as pressure increases, photometrical tests have been made with an ordinary No. 4 Kern burner; different sized nipples being used, and the burners adjusted to obtain the best results at each given pressure.

Pressure in Tenths.	Flow of Gas. Cubic Feet.	Illuminating Power.	Average Candle Power per Cubic Foot.
15	4·9	90	18·3
20	5·5	103	18·7
30	5·1	100	19·6
40	5·5	120	21·8
50	6·3	143	22·7

Governors for ordinary conditions should not be extensively used, as they cause complaints of bad supply, materially reduce

pressures, stick, and get out of action quickly. Consumers, I find, when advised to dispense with their use, are always satisfied with the after-results, though sometimes it is a very difficult matter to convince them. Regulation should take place on the consumer's premises at the burner. A governor when used to keep a uniform pressure of gas delivered from compressing plant, is certainly in its place; but to adopt it commercially means some trouble. The simplest means of checking the gas supply is at the meter-tap, or at each individual point; or a still better method is the "gas-adjusting nipple." By the use of this nipple you can obtain an equal duty in every spot. In adopting the adjustable nipple, it is necessary for it to be of very fine manufacture, made perfectly true, and with a smooth edge. Better results are obtained from one that has a centre adjusting movement, because I contend that gas should impinge from the nipple in the direct centre of a bunsen tube, and not by shutting off one, two, or three of a number of holes, as the case may require. To illustrate the value of this nipple, I fitted a No. 4 Kern burner with one, and the photometrical readings were as follows:—

Pressure in Tenths.	Flow of Gas, Cubic Feet.	Illuminating Power.	Candle Power per Foot.
15	4·4	87	19·7
20	4·7	95	20·2
30	5·2	115	22·1
40	6·0	138	23·0
50	6·3	153	24·2

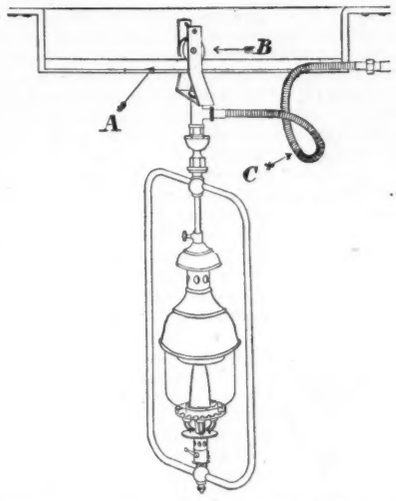
Comparing the above figures with those of the ordinary nipple already given, clearly proves that the adjustable nipple is going to play a very prominent part in gas lighting.

I consider the most perfect inverted burners are those of the swan-neck type, with the air-chamber lower than the ignition-point, as this brings it back to a very great extent to the ordinary upright, which is a more natural way of burning gas than being delivered entirely in a downward direction. There are, however, still vast improvements required to make the inverted burner an absolute success. Though the "C" burner is rather obsolete, it still plays a very prominent part, and is a burner which will give results where others have failed. Improvements have been made in burners built on the lines of the "C" with very satisfactory results. This type of burner is the cheapest of any to maintain. The Kern burner for low-pressure lighting still stands supreme; and I have never come across its equal for lighting efficiency per cubic foot, though it is costly to maintain, when compared with others. Self-intensifying systems passing over 10 cubic feet of gas per hour are not desirable; but smaller lamps give very good results, particularly those of the recuperative type. When advising consumers to lay down high-pressure plants, care should be exercised as to whether it is to their advantage. I find to lay down a high-pressure installation at 8 inches for a candle power of (say) 2000, does not warrant the capital outlay; and it is far better to use a little more gas than pay interest.

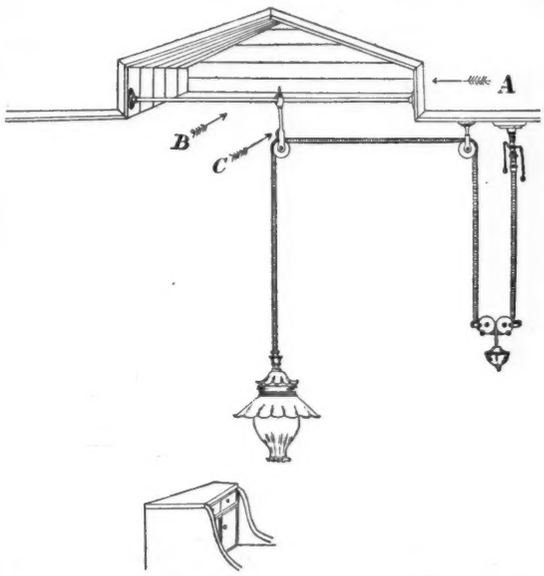
It is really a matter of experience to determine the amount of light required for a given area; but the rule of 1 candle for every 3 square feet of floor area is a very good standard to work upon assuming as a basis the room to be lighted to have a white ceiling and walls, and lights placed 9 feet high, increasing the power according to the colour of walls, decorations, or obstructions. An increase of 5 to 7½ per cent. in candle power will usually suffice for every foot over and above 9 feet in height. The general public, to my mind, have a great tendency for increased light, which is certainly very harmful and destructive to the eyesight, especially the rays given from the electric arc. Of late, there has been a great rage to adopt the four-burner cluster lamps for inside use, ranging from 250 to 500 candle power in one unit of light. To fix a lamp with this number of burners, for lighting shops or rooms say 14 ft. by 16 ft. by 10 ft. or 12 ft. high, is wrong, and of very little benefit to the consumer. It is infinitely better to instal cluster lamps with a less number of burners. All lights, as far as possible, should be hung from the ceiling, and every endeavour made to have the mantle suspended in a direct line with the cup and ball, so that when globes or any parts are removed for cleaning purposes the mantle is left still in the vertical. Tee pendants and all fittings of this class should be avoided, because according to the weight of removable parts, so the mantle is thrown out of the vertical line. This causes the mantle fringe to break, and also strains the loops and shoulders. I estimate these fittings increase the maintenance cost at least 33 per cent. The disadvantage of this class of fitting applies more to the upright than to the inverted burner, as the clay rings take up the strain. For outside shop lighting, there seems to be a great tendency for four-burner lamps. I cannot understand why. You get practically the same results with three-light lamps, reducing wear and tear and gas consumption 25 per cent., and giving the consumer more satisfaction. Cluster lamps should be used in preference to single burner, as you have always a fall-back in case of breakage of mantles.

To overcome excessive vibration, I have not yet found anything to surpass the elongated spring. A fitting suspended from cup and ball, having practically the whole of its weight at the bottom, will take up a certain amount, where buildings are near railways, and in places where vibration is of a slight character. Fittings suspended by a chandelier chain, also flexible metallic tubing, take up a considerable amount of vibration. In the latter case, the fitting should be a very light one. For distance lighting, the pneumatic air-pressure system is the one I have adopted with very satisfactory results.

[The author next described a few methods he has devised for bye-passing automatic and alternate lighting and extinguishing and then referred to the two travelling lamps which we illustrate.]



Lamp for Sliding In and Out of Shop Windows, &c.



Rise-and-Fall Pendant, Fitted in Skylight.

The first illustration shows a lamp fitted for sliding in and out of deep shop windows, gangways, cellars, &c. The design comprises a length of ½ inch tee or bar iron bent to shape A; a lamp-carrier and grooved wheel B; and a metallic tube supply C. The second illustration shows a rise-and-fall pendant fitted in the skylight A; the fittings comprising a rod B, and sliding-carrier C. A fitting adapted in this way, he said, is very useful for altering the position of light, particularly for desk work. All fittings supplied by flexible metallic tubing for outside use should be copper, and in every case fitted with a control tap at the inlet. They require to be periodically inspected, in order to prevent the metallic or other connections giving out. This can be done by the maintenance staff.

I do not think that the maintenance department should be run at a heavy loss, even as an advertisement. It should certainly return the cost of material and labour. To my mind, supervision, management, and establishment charges, are quite sufficient loss to warrant the satisfaction of consumers.

Details of each consumer's installation should be kept, including position and description of lights; and provision should be made for remarks in the event of any peculiarities—such as excessive vibration, abnormal dust, and situation of premises—so that you always have at hand a ready reference for any future occasion. In organizing a maintenance staff, it is absolutely necessary to employ the most skilled workmen available, as on them the working results largely depend. As the result of my experience, I find that it is false economy to employ cheap labour on such delicate work.

Maintenance contracts should be undertaken on a yearly period, where an unlimited supply of mantles is specified, except where business houses do not require light during the summer months. In these cases, special quotations may be given. In contracts where you have a limited supply of mantles, there is

no reason why any definite period should be fixed. Attendances should be made in most cases weekly for factory, warehouse, outside, and public-house lighting. For the majority of shop, church, and private house lighting, I find that fortnightly visits are sufficient for ordinary purposes. A separate card for each consumer should be kept. Each consumer's details should be recorded separately, and all materials be booked up in a separate account. Before contracting to maintin an installation, a separate charge should be made for putting burners in good order. Repairing of burners should be an extra charge, except gauzes or inexpensive tops. Obviously, replacements when the breakages are caused by the consumer's employees should be an extra charge. Maintenance men should be provided with a daily work-sheet recording a summary of the work done, number of burners maintained, and what materials have been used, together with any remarks.

The average mantle consumption per burner should be worked out for each man's daily task, and the same for the week, afterwards making a summary of the total number of burners maintained. This enables one at a glance to locate any excessive use, leakage, or discrepancy—giving exactly the daily, weekly, and total cost, and at the same time indicating the most capable and efficient employees. All empty boxes should be returned; and any discrepancy under or over should be satisfactorily explained by the workman. All mantles broken in burning off should be replaced in the box, marked, and returned, and noted in the "Remarks" column of the work-sheet. These will in most cases be allowed for by the manufacturers. It also affords reference of any peculiarities in each particular make. Mantles should be removed as little as possible, unless a dirty gauze top or cone deteriorates the light. Nipples should be thoroughly cleaned at each call. When new mantles are fixed, burners should be taken apart and thoroughly cleaned. Men should notify the consumer of anything defective, more especially before commencing cleaning, and ask for an order for repairs—also to be noted in the "Remarks" column of the daily work-sheet. In order to prevent disputes, all entries on the card should be made in indelible ink pencil, and signed in the same manner. Mantle ash should be returned, as this brings a high price for extracting thorium, particularly if that precious article is cornered.

The following tabulated statement, showing the cost of maintenance by weekly or fortnightly visits for low or high pressures, will explain the advantage of having the average mantles used per burner, per visit, of each man's work brought under your notice daily, and at the end of each week. By this method, you are not only kept in touch with the approximate cost, but can make working arrangements accordingly.

Discussion.

The PRESIDENT said that before the paper was discussed, they ought to give their best thanks to Mr. Tooth for his very well thought out contribution; and he had much pleasure in proposing that this be done.

Mr. H. ROTHWELL seconded the vote; and it was carried.

Mr. S. A. CARPENTER asked the number of burners cleaned per man per day, and said he would also be glad to know whether the author could give any explanation of the high cost of maintaining the Kern burner.

Mr. G. W. G. TATAM remarked that he should like first of all to thank the members very much for having given him the opportunity of hearing this very able paper. It would be apparent to them all that Mr. Tooth understood his portion of the business; and to those who, like himself, were kept inside the works all day looking after the manufacture of the gas, such a paper as his was an education, because they were not able to gather this information for themselves from personal observation. It was a great benefit to them to have a man like Mr. Tooth to give them the information, without them incurring a lot of labour which they could ill afford the time for. He had referred to the cheap German fittings; and he (the speaker) was quite in agreement that the English fittings were very much superior. In all metal work the English was far better than the German. The author had also made a point of the importance of pressure. Well, it had always been a great wonder to him that the English gas companies and corporations had not gone in more thoroughly for high pressure distribution. They were considering in the Midlands some eighteen months ago the question of supplementing the supply to outlying districts by means of a high-pressure main. They went into the matter, and found it all right so far as the pipe-laying was concerned; but the difficulty was in getting governors that would enable them satisfactorily at periods of slight draught to keep up the pressure in the pressure mains without allowing excessive leakage into the other mains and blowing the meters. Experiments were carried out; and there were really no governors that were entirely satisfactory at very high pressures. He did not know whether this was the experience of any of those present; but the same thing was found by the Mond gas people when they were making investigations with very high pressures. He quite agreed with the author's remark as to the clustering of burners—that this had a tremendous effect on the illumination derived from the quantity of gas burnt. Very often they saw it announced that a burner would give 30 candles per foot; and it was argued that if one burner gave this amount of light, a number would give simply the multiple of that. On actual tests, however, he found that the grouping of burners had a great effect on the illuminating efficiency. Some of the mantles tended to obstruct the light of the others; so that he thought the mantles should be kept as far from one another as possible. He mentioned that he was one of the original members of the London and Southern Junior Association, having been present at the inaugural meeting; but unfortunately he left London

Tabulated Statement showing Cost of Maintenance for Various Classes of Consumers.

Low Pressure.

Position.	Description of Burner.	Average Mantle per Burner.		Average Mantle per Burner per Annum.		Average Cost of Mantles.			Average Cost of Labour per Burner per Annum.		Total Cost.	
		Weekly Visits.	Fortnightly Visits.	Weekly.	Fortnightly.		Weekly.	Fortnightly.	Weekly.	Fortnightly.	Weekly.	Fortnightly.
							s. d.	s. d.	s. d.		s. d.	s. d.
Private house	"C"	·075	·14	4·02	3·66	2½	0 10·05	0 9·15	1 5·16	9·36	2 3·21	1 6·51
	Sugg	·115	·21	6·0	5·46		1 3·0	1 1·65			2 8·16	1 11·01
	Kern	·115	·22	6·0	5·73		1 3·0	1 2·32			2 8·16	1 11·68
	Inverted	·070	·12	3·6	3·12	3	0 10·8	0 9·36			2 3·96	1 6·72
Shop lighting	"C"	·145	·27	7·6	7·02	2½	1 7·0	1 5·55	1 5·16	9·36	3 0·16	2 2·91
	Sugg	·150	·28	7·8	7·38		1 7·5	1 6·45			3 0·26	2 3·81
	Kern	·160	·30	8·4	7·80		1 9·0	1 7·50			3 2·16	2 4·86
	Inverted	·165	·30	8·6	7·87	3	2 1·8	1 11·61			3 6·96	2 8·97
Public house	"C"	·130	..	6·8	..	2½	1 5·0	..	1 5·16	..	2 10·16	..
	Sugg	·155	..	8·2	..		1 8·5	..			2 10·66	..
	Kern	·165	..	8·6	..		1 9·5	..			3 2·66	..
	Inverted	·169	..	8·8	..	3	2 2·4	..			3 7·56	..
Warehouse	"C"	·115	..	6·0	..	2½	1 3·0	..	1 5·16	..	2 8·16	..
	Sugg	·157	..	8·2	..		1 8·5	..			3 1·66	..
	Kern	·173	..	9·0	..		1 10·5	..			3 3·66	..
Factory and machine-shops	"C"	·155	..	8·0	..	2½	1 8·0	..	1 5·16	..	3 1·16	..
	Sugg	·138	..	7·2	..		1 6·0	..			2 11·16	..
	Kern	·165	..	8·6	..		1 9·5	..			3 2·66	..
	Inverted	·200	..	10·0	..	3	2 6·0	..			3 11·16	..
Outside lighting	"C"	·146	..	7·6	..	2½	1 7·0	..	1 5·16	..	3 0·16	..
	Sugg	·163	..	8·5	..		1 9·2	..			3 2·36	..
	Kern	·200	..	10·0	..		2 1·0	..			3 6·16	..

High Pressure.

Lighting.	Average Mantle per Burner. Weekly Visits.	Average Mantle per Burner per Annum.	Average Cost of Mantles.		Average Cost of Labour Weekly.	Total Cost.	Candle Power.
			d.	s. d.		s. d.	
Shop	·170	8·9	6	4 5·4	1s. 9·5d.	6 2·9	300
Warehouse	·188	9·8	6	4 10·8		6 8·3	300
Factory and machine-shops	·200	10·4	6	5 2·4		6 11·9	300
Outside 8 inches	·260	13·6	6	6 9·6		8 7·7	300
Outside 16 ,,	·280	14·5	8	9 8·0		11 5·0	600

shortly afterwards, and so was unable to keep in touch with it. A little more than a year ago, however, he was able to become connected with another Junior Association—the Midland. They had had a great success with this, aided by the influence and support they had received from the members of the Senior Association, who went to a great amount of trouble in carrying out the inaugural meetings and correspondence. Since the start of the Association, the Seniors had shown the greatest sympathy with the members; and they usually had some of them present at their meetings.

Mr. F. WINDMILL, referring to inverted burners, remarked that the author had said, and no doubt truly, that there were a lot of cheap burners on the market at the present time. It was most desirable that they should have a good burner which the automatic consumer could use; and it must be as simple as possible, so as not to require the attention of the maintenance man. They must not lose sight of the fact that the gas supplying authorities had much to thank the poorer people for in using gas when so many of the richer class had ceased to do so. In nine cases out of ten, they would find the poor man had his gas-stove and his gas-burners; and therefore they must not too severely criticize the cheap German goods. He would like to see the English makers turn these burners out at a fair price.

Mr. E. W. ELDRED believed Mr. Tooth stated that inverted burners had a limited scope at present; but he (the speaker) thought they would be the burner of the future—especially as gas suppliers were now endeavouring to get the illuminating power reduced. When this became general, inverted burners would be more largely in vogue than ever, not only for inside illumination, but for public lighting also. He quite agreed with what had been said with regard to the four-burner lamps. As to anti-vibrators, he was of opinion that the principle of attaching the anti-vibrator to the burner was wrong. With reference to men, many people who were placed in charge of a department got worried, and if one of their men misconducted himself or did not carry out his work satisfactorily, the first thought was to get rid of him. This should be the last resource. He might be suspended; but they should not discharge him if it was possible to avoid it. They should keep a man as long as possible, because it was harder to train a new man from the start than to keep a man who had already been trained up to a certain point.

Mr. F. AINSWORTH understood the author to say that a mantle lasted longer with high pressure than with low pressure. He, however, could not see how working a mantle at high pressure was going to make it last longer. He strongly disapproved of the four-burner lamps; his own experience being that with lamps of this size they did better with two burners. The object was to get the greatest amount of light possible from the smallest quantity of gas. Mr. Tooth said they should buy largely and cheaply; but in this respect big companies had an advantage over the smaller ones, who could not purchase so extensively, and therefore had to pay a little more. A standard thread was very necessary. The use of different sized threads was a nuisance, and created a great amount of worry, labour, and expense. His own opinion was that for globes, &c., there was nothing like English-made glass. Perhaps it was not so clear and bright as they obtained sometimes from abroad; but there was no doubt it would last better. It was toughened, and did not crack or break so soon as foreign-made glass. He did not think that the employment of glass with inverted burners was at all suitable for church or chapel lighting, or for other public buildings, where they hung right overhead. There were several risks. The screws might be too tight, and not allow for expansion; and then, again, perhaps there might be a hole in the mantle, the heat would penetrate through, and the glass might then break. He was, of course, quite prepared to learn that many people did not agree with him in this. No doubt, it was desirable to keep up a good pressure in the district. In Ilford there had been a very large falling off in the number of complaints since the pressure was raised. They now worked at from 3 to 4 inches pressure; and in some parts of the district it was a little more than this. As to tee pendants, there was no doubt that in many cases they were useful in distributing the light. Certainly the inverted burner had come to stay; and the improvements made in it during the past twelve months had been very great. It was much better than the electric light. He was pleased to say that they could now put in a very good burner at the workman's price.

Mr. W. J. LIBERTY said he was glad to hear the remarks about the four-burner lamps. For outside lighting, they found they obtained a far better illumination with small units than with a large cluster of burners. They must get a proper supply of air in the lamp; and not only this, but if the mantles were very close together the man in attending to one would be apt to knock another off. He found they did not want clusters of four or six burners for public lighting; and where they had six, they could very often do with three. They had to consider whether the little extra illuminating power was worth the additional cost. He had been making some experiments with reference to the use of inverted burners for street lighting; and he still had to complain of firing-back. If they could only get over this, he thought there was a big future for the burner for outdoor purposes, on account of its being shadowless. When inverted burners were used for public buildings, halls, &c., he would suggest that they should be employed without globes. He had seen a number fitted up in the style of a sun-burner in the roof of a building. They were giving a most magnificent light, and in addition were ventilating the place. He did not think any British-made glass was better than the Jena.

Mr. J. HEWITT remarked that he thought there had been patented a specially made screw with a spring, so that it took up the expansion of inverted lamp globes.

Mr. D. J. WINSLOW thought Mr. Tooth had been too severe on the four-burner lamp. There had been thousands of them, he should think, fitted in London alone. He recently saw a man for whom he fixed up one of these inside lamps twelve months ago; and he said he was perfectly satisfied with it, and that it had displaced twelve ordinary "C" burners. For outside purposes, he agreed that the heat and weather very much affected the lamp. As to maintenance, the author did not state the number of burners maintained at each place. This was a factor that needed considering, in relation to the item of labour. There was not much difference shown between public-house and shop lighting. He should have thought the former would be much greater.

Mr. TOOTH replied fully to the points that had been raised in the discussion. In the course of his remarks, he said that on the fortnightly system a man would attend to about 120 to 140 burners per week; while on the weekly system the figure would perhaps be from 150 to 160. The number, however, varied according to a man's ability. The high cost of maintaining Kern burners, was because the flame of the "C" burner was softer and not so lively. The twist on the Kern wheel was also the cause of mantles curling up and splitting. He agreed that with cluster lamps the burners should be kept as far apart as possible. It was true that the inverted burner promissd to be the burner of the future, and they wanted cheap, but good, ones for the poorer classes of consumers. He might, however, mention that reliable inverted burners could be procured from Birmingham at a cost of about 9d. each. It was most desirable that makers should produce patterns to which a standard mantle could be fitted. It was quite a mistake on their part to put so many burners on the market requiring different mantles.

Mr. H. W. HARRISS (who was present at the meeting, but who, not having at that time been notified of his election as a member, did not think it was in order to speak) writes: "With reference to the remark made by one of the gentlemen present that inverted burners would be a source of danger when fitted with globes in churches and public buildings, on account of the probability of any broken glass falling upon the heads of an audience, I think such a statement is calculated to damage the reputation of a valuable type of burner, and is likely to help our opponent the electric light. There is no doubt that a well-constructed inverted incandescent burner is an ideal burner for churches and public buildings, and for use generally, and superior to the electric light. This has been proved to be so in the cases of Stockingford Church, Nuneaton, and St. Nicholas Church, Kenilworth, which buildings have been fitted up with Helps's patent inverted incandescent burners and very artistic "Ecliptic" fittings. Mr. Helps has devised a novel method of attaching the globes to the burners, which obviates any danger of falling broken globes, and is safer than an upright incandescent burner globe; while the shape of the burners, globes, and fittings, is most artistic and graceful. They have only to be seen to be appreciated. I do not hold a brief for Mr. Helps; but splendid testimonials have been given by the respective vicars and churchwardens of the churches referred to, in which buildings some of the burners have been in use for the last two years, and have put the electric light and upright incandescent burners entirely out of the field."

Sir Richard Tangye, of Glendorgal, Cornwall, and of Coombe Bank, Kingston-on-Thames, the Chairman of Tangyes Limited, engineers, who died on the 14th of October, aged 73, left estate of the gross value of £226,310, of which the net personalty has been sworn at £219,453.

The Hungarian chemist Brumm claims to have discovered a liquid chemical compound which renders certain kinds of matter proof against the effects of time and the elements. He asserts that it will double the density of nearly every kind of stone, and render it waterproof. It is said to impart to all metals those qualities which resist and defy oxygen and rust.

The President of the Board of Trade has appointed Mr. Hubert Llewellyn Smith, C.B., to be Permanent Secretary to the Board of Trade (from the 15th prox.), in succession to Sir Francis J. S. Hopwood, K.C.B., K.C.M.G., who has been appointed Under-Secretary of State for the Colonies. Mr. Arthur Wilson Fox, C.B., will be Comptroller-General of the Commercial, Labour, and Statistical Departments of the Board of Trade, in succession to Mr. H. Llewellyn Smith.

At an exhibition of scientific and industrial apparatus organized by the Physical Society, held at the new buildings of the Royal College of Science, South Kensington, on the 14th inst., Messrs. Alexander Wright and Co., Limited, had on view a Simmance and Abady combustion recorder, which automatically samples and analyzes the products of combustion passing along a flue—the percentage of CO_2 present and the chimney draught being registered on the same chart; while a number of exhibits were made by the Cambridge Scientific Instrument Company.

SMALL WATER SUPPLIES.

At a Meeting of the Association of Engineers-in-Charge, at the St. Bride's Institute last Wednesday week, Mr. H. C. H. Shenton read a lengthy paper on "Small Water Supplies;" and he illustrated it by a number of drawings and charts which proved most interesting to his audience. The paper (which was followed by an animated discussion) was a sequel to the one on the same subject which Mr. Shenton previously read before the Association last session (see "JOURNAL," Feb. 20, p. 495). Mr. Arthur Davey occupied the chair.

On the first occasion, Mr. Shenton enumerated the English water-bearing strata, and then dealt at length with the subject of well construction; while in his second paper he considered how, having obtained the water, the supply might be best conducted to the places where it was required. It was pointed out that pumping should be avoided if possible, and a gravitation scheme (which was the best and cheapest plan) be arranged for. If the supply was practically inexhaustible, nothing in the nature of a very large reservoir would be needed; while if the water came from an intermittent source, a very big one might be required. If the supply was continuous but small, a storage reservoir would be needed sufficient to hold all that came, letting it flow out into the mains when required at a quicker rate than that at which it entered the reservoir. The many types of service reservoirs in use at the present time were explained; the author remarking that those of a circular form were often cheaper than rectangular ones. As to ferro-concrete reservoirs, he thought, speaking generally, it appeared that, weighing evidence from various sources, the cheapest, and at the same time most efficient, service reservoir was likely to be one constructed in ferro-concrete and rendered with cement mortar.

It was, the author remarked, an undoubted fact that small leakages, cracks, &c., had a tendency, from one cause or another, to cease to let water pass out of a reservoir through them after a certain time. They were said to "take up." It was not, however, always a very satisfactory thing for the engineer-in-charge to have to depend upon this "taking up" process in order to pass an obvious leakage, small though it might be; and it might be practically impossible to ascertain the cause of such leakage from an ordinary inspection. The author had found that the best method of dealing with such a case was, first, to allow the reservoir to stand full of water (say) for a couple of days; and then to let all the water out, and watch the walls and the floor as they dried. Every porous patch or cracked place in the walls remained damp after the other part of the wall was dry; while cracks, which had been quite inappreciable under ordinary conditions, became apparent owing to the damp line along the wall, which indicated their course. It would then as a rule not be difficult to trace the causes of the slight leakage. With regard to this small leakage from reservoirs, it should, he said, be remembered that rendering which was not worked to a polished face was apt to be porous; and so the importance of working up the cement to a polished face became evident. In Mr. Shenton's opinion, this should be obtained by trowelling the cement mortar, and not by adding any skimming coat of neat cement.

On the subject of water-main problems, the author explained one or two simple methods of calculating the approximate discharge of a pipe; and he said, with regard to the laying of water-mains, that it should be the object of the engineer to form circuits. It was pointed out that, if two 6-inch mains left a reservoir and formed a circuit round a whole district, or section of a district, people at the far end of the loop, being able to draw their supply through two 6-inch pipes instead of only one, would have a much greater quantity of water at their command; while at the same time the circulation of the water would keep the whole system clean. It was also a good thing, wherever possible, that branch mains should form circuits. In this way, there would be a good circulation throughout the system; stagnation at any point would be impossible; and the largest supply under the greatest pressure would always be available for use. Though it was not always possible to do this in practice, it was an ideal that should always be kept in mind, especially in the case of small systems, where the extra expense (if any) would sometimes not be very great. The second object of the engineer in designing a system was that it should be under perfect control by means of valves. Each section of the system should be so arranged that it could be cut off by closing its valves; and each branch should be governed by a valve where it left the main.

Mr. Shenton gave a mass of useful information on the subject of main-laying, joints, hydrants, &c.; and altogether his paper (which we regret we have not space to notice more fully) was of an extremely interesting and practical character.

In tests of alcohol as fuel for internal combustion engines, an American gas-engine manufacturer has found that, while a much smoother running engine is the result, owing to the higher compression possible and the slower combustion rate with alcohol, the extravagant claims for low costs of operation are not to be realized in practice. The amount of fuel consumed, under a wide range of operating conditions, was found to be practically the same per H.P. hour as with gasoline for fuel, averaging for small units about 1 gallon per H.P. for 10 hours.

CORRESPONDENCE.

[We are not responsible for the opinions expressed by Correspondents.]

A New Gas-Works' Clauses Act.

SIR,—I read with much interest the "Editorial Notes" in the issues of the "JOURNAL" for the 11th and 18th inst., and Mr. F. N. Keen's important and instructive letter on the above subject. I am pleased to see that the gas clauses of the Model Bill as amended in the present year now give gas undertakings who are in Parliament with a Bill, and are astute enough to profit by their opportunities, just the freedom with respect to discounts for trade purposes for which I have so often contended. So far so good; but this advantage can only be obtained by going to Parliament, which, as at present constituted, is a rather risky proceeding for a gas company to adopt. I also note with considerable satisfaction that the model clauses stipulate for the adoption of the "Metropolitan" argand No. 2 as the standard burner.

Now, if we were to secure a new Gas-Works Clauses Act containing these two items, all the gas undertakings in the country would immediately reap the benefit, without jeopardizing their existence by going to Parliament. It seems to me that these benefits would be very easy to acquire, as they are already contained in the model clauses. Then numerous other advantages could also be obtained at the same time; and I think it is very desirable for us to take this matter in hand while we have such a golden opportunity.

Wakefield, Dec. 21, 1906. H. TOWNSEND.

Gas from the United-Otto Coke-Ovens.

SIR,—My attention has been called to an article appearing in your issue of Sept. 4, p. 628, under the heading "Gas from the United-Otto Coke-Oven Plant," in which reference is made to this Company.

In justice to all concerned, I believe a statement is due from us correcting an impression which I judge that the "JOURNAL" has, and which may be shared by a large number of your readers, that our Everett plant, with its 400 Otto-Hoffman bye-product ovens, is not a success practically or financially. In the article referred to, you state, "No information is vouchsafed as to what constitutes successful operation."

Perhaps the best testimony as to what "constitutes successful operation" is a statement showing the results obtained while operating continuously the original installation of 400 ovens. Such a statement I enclose as part of this letter.

Summary Statement.

Period.	Gas. Full 18-Candle Power.	Coke.	Tar.	Ammonia.	Net Earnings.
	Cubic Feet.	Tons.†	Gallons.	Tons.*	
Oct. 1, 1902, to June 30, 1903	1,394,458,000	306,349	3,907,766	4076	$410,463 84†
July 1, 1903, ,, ,, 1904	1,799,793,000	403,781	5,099,475	5168	233,245·43
,, 1904, ,, ,, 1905	1,800,223,000	440,627	5,469,681	5717	319,124·85
,, 1905, ,, ,, 1906	2,261,945,000	471,697	6,282,099	6086	588,862·63

* 2000 lbs. † Nine months.

The statement dates from the time of the reorganization of the Company in October, 1902, and ends on June 30, 1906—our fiscal year ending on the latter date.

The net profits shown are with all operating, executive, taxes, and other expenses deducted. The amount of gas shown is the surplus sold to the neighbouring gas companies for city distribution. All of this gas averages above 18-candle power, without enrichment. The price of the gas to the various companies is fixed at a rate lower than their manufacturing cost; and the price is subject to the approval of the Massachusetts Board of Gas and Electric Light Commissioners. Practically all of our coke has been and is sold for domestic and steam purposes—its high sulphur content preventing its sale for metallurgical use.

I trust that the above will prove of interest, and that you will give the subject of this letter its proper place in your "JOURNAL."

J. L. RICHARDS, President,
The New England Gas and Coke Company.

Boston, U.S.A., Dec. 7, 1906.

Sulphur in Gas.

SIR,—I am often surprised at the frequent complaints as to the sulphur difficulty which I find in the columns of the "JOURNAL." I am not a member of the gas profession, but have been for over fifty years conversant with the management of a small gas-works, making under 30 million cubic feet per annum, and am a constant reader of your paper.

We have now no trouble as regards sulphur, as was the case in former times. Our plant is of ample size for the quantity of gas required. After the condensers, the gas passes—not too rapidly—through a Livesey washer, a "Standard" scrubber, three oxide purifiers, and (to finish) a large lime purifier. We have no means of making delicate chemical tests for the presence of sulphur; but we have no reason to believe that it exists in the gas to any appreciable or injurious extent. Is not the presence of sulphur in gas largely owing to the insufficient size of purifying apparatus in large works?

Dec. 12, 1906. GAS CHAIRMAN.

Unreliability of the Electric Light.

SIR,—Another demonstration of the fickleness of the electric light was given yesterday (Wednesday) in the neighbourhood of Oxford Street. At about six o'clock in the evening, for twenty minutes or more, all the new installation of flame arc public lighting just completed a short time ago, failed, as did also the lighting of many business premises, shops, &c.

Personally, I was doing a little Christmas shopping at Messrs. Warings, when suddenly the whole place was plunged into absolute darkness; and for a few minutes one feared that a panic would ensue. The darkness was such that even the emergency oil-lanterns could not be got, for fear of running into obstacles.

Apart from the probability of panic, it makes one tremble to think of the possible consequences (to a firm like Messrs. Warings) of the opportunity an occasion like this gives to thieves who may be in the building, besides paralyzing their Christmas business for twenty minutes at such an important time. This is only one illustration of the inconvenience of the electric light failing,

What would happen if gas failed? We should never hear the last of it; but we can rejoice in the knowledge that such a calamity is not likely to occur with gas.

Dec. 20, 1906. GAS ADVOCATE.

[Alluding to the failure referred to above, the "Evening News" last Thursday wrote, in jocular strain: "An illuminated address on vellum is shortly to be presented by the Shop Lifters' Association to the Marylebone Borough Council, the failures of whose electric light system are greatly appreciated by members of the former body."—ED. J.G.L.]

LEGAL INTELLIGENCE.

SUPREME COURT OF JUDICATURE—COURT OF APPEAL.

Tuesday, Dec 18.

(*Before the* MASTER OF THE ROLLS *and Lords Justices* COZENS-HARDY *and* FARWELL.)

Fletcher's Executor v. Corporation of Birkenhead.

This was an appeal by the defendants from the judgment of Mr. Justice Bray in an action heard at Liverpool, in which his Lordship gave judgment in favour of the plaintiff, who had since died; and his Executor had consequently been added as a party to the appeal.

Mr. HORRIDGE, K.C., and Mr. F. E. SMITH appeared for the appellants; Mr. PICKFORD, K.C., and Mr. LESLIE SCOTT represented the respondent.

The question raised by the case was one of considerable importance to public bodies—viz., whether the rules laid down by the House of Lords in the *Hammersmith Railway v. Brand*, that an injury sustained owing to the authorized working of the railway was not an injury in respect of which compensation could be claimed, governed this case. In the present case, the injury was sustained by the owner of property in respect of the authorized working of water-works; and it was argued that, by analogy, compensation was not payable. The facts of the case were shortly these: Plaintiff brought his action claiming £1200 and costs, which sum had been awarded him by Mr. Gott, the Umpire in an arbitration, as compensation for injurious affection to his land, dwelling house, and premises known as Brookside, Upton, by the exercise by defendants of the powers conferred upon them by the Birkenhead Corporation Gas and Water Act, 1881. Under this Act, defendants had acquired a piece of land at Fordbridge, and had sunk a well or borehole thereon about 150 yards from plaintiff's dwelling house, and prior to 1904 had been pumping large quantities of water from the well. Plaintiff alleged that, in consequence of this pumping, a mass of silt had been abstracted from under his house, and a settlement had been caused, owing to the support being withdrawn, and great damage had been done to the house. A claim being made for injurious affection, the matter was referred to arbitration; and in the result, the sum of £1200 was awarded. At the arbitration, it was urged that plaintiff was not entitled to compensation, even if the house had been affected in the way suggested. The Umpire found certain questions of fact, and also that the Corporation had, by the authorized working, after completion of the works, occasioned damage to the property of the plaintiff; that such damage was not occasioned by the abstraction of water only, but by the abstraction of water which carried silt with it from under plaintiff's premises; and that the weight of the building upon the land had not occasioned the damage. Upon the matter coming before Mr. Justice Bray, it was contended for the plaintiff that the defendants were authorized by section 12 of the Water-Works Clauses Act to take water, and that it was by the exercise of this power the damage was caused; that, but for the authority conferred on defendants by the Act, the wrong would have been actionable, inasmuch as by it plaintiff was deprived of support to his house, and that section 12 or section 6 entitled him to compensation. For the defendants, it was contended that section 12 conferred no power upon them, except to take water for the purpose of construction; and as the water was not taken for this purpose, section 12 gave no right to compensation. Further, it was urged that the power to take water in construction was impliedly given by the Special Act, section 20, to which plaintiff replied that, if it was so given, he was entitled to compensation under section 6. Defendants further denied that the wrong would in any case have been actionable. His Lordship held that any difficulty which existed was cleared away by the answers given by the Umpire, as his findings brought the case within the authority of *Jordeson v. Sutton, Southcoates, and Drypool Gas Company*. From this finding the defendants appealed, relying upon the case of the *Hammersmith Railway v. Brand*.

Their Lordships, without calling upon respondent's Counsel, dismissed the appeal with costs.

We learn that Messrs. William Beardmore and Co., who are now manufacturing gas-engines of the Oechelhaeuser type, under licence, are about to ship a consignment of about 600 tons of engines which are to work on the suction-gas system.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

Thursday, Dec. 20.

(*Before Mr. Justice* KEKEWICH.)

In re the Kent County Gaslight and Coke Company, Limited.

Mr. LAWRENCE, K.C. (with him Mr. MARTELLI), moved, to-day, on behalf of several shareholders, to have their names removed from the list, on the ground that they had been induced to take shares through misstatements in the prospectus. In one case, that of Mr. Hines, Counsel said he would withdraw the application so far as it related to preference shares. The facts were the same as in the cases tried by Mr. Justice Joyce (see *ante*, p. 689), and he presumed the same order would be made.

Mr. KIRBY, who represented the Company, pointed out that Mr. Justice Joyce had only found one issue proved—viz., misrepresentation as to one of the Directors; and he supposed this was what was relied upon by his learned friend, as there was no evidence on the file as to the falsity of other statements in the prospectus.

Mr. LAWRENCE said he was content to rely upon the finding of Mr. Justice Joyce upon the facts.

Mr. KIRBY said some of the cases now before the Court differed from the others, as here the application was made in December, while the others were made in June. He was prepared to put the Secretary in the box to prove that all the shareholders had received notice of the withdrawal of Mr. Darwin.

Justice KEKEWICH said he should certainly take the same view as Mr. Justice Joyce had done. The order in these cases would be the same as in those which had already come before the Court.

Mr. HODGES said he had a similar application to make on behalf of Mr. T. A. Baker, who applied for five preference and five ordinary shares. Applicant had filed an affidavit in which he swore he applied for shares on the faith of the accuracy of the statements made in the prospectus.

Justice KEKEWICH said there would be the same order in this case as in the others.

Friday, Dec. 21.

This morning motions by several other shareholders in the Company were mentioned.

Mr. KIRBY said he had only just received the affidavits, and he must ask for them to stand over.

Mr. LAWRENCE said that in one case the Company had had the affidavits for some time; but he did not object to all of them standing over till the next sittings.

Mr. WHINNEY subsequently moved, in the action brought by Mr. Whitaker against the Company (*ante*, p. 827), on behalf of Mr. W. J. Dempsey, the holder of 50 preference shares of £5 each, to stay execution of the judgment, on the ground that a petition for the winding up of the Company had been presented. The judgment was obtained on the 14th inst.; but a petition by three shareholders had already been deposited, and was to be heard on the 15th prox. The application was made under section 85 of the Companies Act, which provided that the Court might, at any time after the presentation of a petition, and before making any order, on the application of a company or any creditor or contributory, restrain further proceedings in any action against them on such terms as might be thought fit.

Mr. MARTELLI, representing the plaintiff in the action, said a great many orders had been made against the Kent Company, and this was the only case in which an application had been made to stay the proceedings under the section cited. In the other cases, a stay had been granted pending an appeal, but only on the terms of the money being brought into Court; and he submitted that a stay should not be granted in this case except on the same terms. In any event, there ought to be an undertaking in damages by a substantial person, not by the Company, which was not substantial; neither, so far as they knew, was anyone connected with it.

Justice KEKEWICH said it was not the Company but a contributory who was making the application; and, according to the practice of the Court, any officer within the jurisdiction was substantial, for the purpose of giving an undertaking, unless there was a suggestion, and more than a suggestion, that he was not. He must therefore make the order on Mr. Dempsey's undertaking.

HIGH COURT OF JUSTICE—REFEREES' COURT.

(*Before Mr.* MUIR MACKENZIE.)

Kellett v. Stockport Corporation.

The claim of Mr. Abram Kellett for damages for breach of contract in connection with the water-works of the Stockport Corporation in the valley of the River Kinder, as reported in our issue of the 27th ult. (p. 624), was referred to the Official Referee, and came up for hearing on Monday, the 10th inst.

For the plaintiff, there appeared Mr. A. M. L. LANGDON, K.C., Mr NORMAN CRAIG, and Mr. J. A. SPEDDING; the defendant Corporation were represented by Mr. W. PICKFORD, K.C., Mr. E. SUTTON, and Mr. C. M. BAILHACHE.

The principal facts of the case were given in our previous report.

Mr. LANGDON occupied the whole of the first day in opening the case—tracing its history, going through the pleadings, specification, reports, and correspondence. The claim for damages is for £7572, retention money; £6079 for work done and not paid for; a sum to be ascertained for work on a tongue-trench; and damages for delay, and generally.

Mr. *Abram Kellett*, examined by Mr. LANGDON, said his first tender amounted to £327,700, and his second, and accepted, one (on a different

basis and schedule of prices) was £248,000. In the course of the work, he came upon a berme or ledge of shale, which he thought was not good enough to carry the weight proposed to be put upon it. He called in Mr. G. F. Deacon and Professor Unwin to advise him. Their reports he sent to the Engineer (Mr. Mansergh) and to the Corporation. He had never had any intention of ceasing to perform his contract.

In cross-examination by Mr. PICKFORD, witness said that he could not build a stable masonry dam according to the original design. Mr. Mansergh's modified design was a considerable alteration.

Mr. *G. F. Deacon*, M.Inst.C.E., was examined, and said he found the bed of shale of very doubtful character. There was not a large factor of safety. It would have been a small matter to have removed the berme. The amended proposals would have resulted in a good dam being secured.

Professor *Unwin* gave evidence as to tests and calculations of the stresses on the dam.

In cross-examination by Mr. BAILHACHE, he thought the scheme as first being carried out was unsafe.

Mr. *A. C. Hurtzig*, M.Inst.C.E., gave detailed figures as to the increased cost of the modified scheme. The modified dam gave a pressure of 8 tons per square foot, which, on a sound rock foundation, was quite an admissible pressure.

Mr. *C. A. Brereton*, M.Inst.C.E., gave corroborative evidence, with particulars as to cost of working in the tongue-trench.

Mr. *Harry Kellett* was examined by Mr. LANGDON throughout Thursday, the 13th inst. He proved all the various figures and prices of the work in question. Six statements were put in, showing in tabulated form how the different items of the claim were arrived at.

Among other witnesses was Mr. *John Cooper*, Fellow of the Society of Accountants and Auditors, who spoke as to the accounts and balance-sheets he had prepared from the plaintiff's books.

On Monday, the 17th inst., Mr. E. SUTTON addressed the Court on behalf of the defendants. The following day, through the illness and absence of the defendants' Counsel, the proceedings were adjourned by the learned Referee till Thursday, the 10th prox.

Water-Works for Brumby and Frodingham.

New water-works for the supply of Brumby and Frodingham, North Lincolnshire, were opened last Thursday by Miss Winn, sister of Lord St. Oswald; the ceremony being followed by a public luncheon. The scheme has been carried out by Mr. A. Atkinson, of Brigg; and the water is intended for purely domestic purposes. The Engineer was fortunate in finding an ample supply of water from the Lincolnshire limestone at Applesby Cars; Lord St. Oswald providing the Council with the necessary land and easements, including the reservoir site, for £1673. A well, 26 feet deep and 9 feet in diameter, with a 45 feet bore, was sunk, and engine-houses and cottage erected, by Messrs. E. Good and Son, of Hull, for £1311. The water is pumped by steam to a covered service reservoir, on the highest ground of Lord St. Oswald's estate, at Soak Nook Wood; and it finds its way by gravitation into the town. Messrs. Glenfield and Kennedy, of Kilmarnock, had the contract for supplying and fixing the engines, boilers, and pumps for £1012; the Staveley Coal and Iron Company supplied the pipes for £2906; and the pipe-laying and construction of the service reservoir were carried out by Messrs. R. C. Brebner, of Edinburgh, at a total cost of £2329. The whole of the work has been executed under the personal supervision of Mr. J. Green, the Assistant-Engineer. An ample and wholesome supply of water is the result; and long pumping tests have been made without appreciably lessening the quantity.

A Return on Municipal Trading in England.

In the House of Commons last Thursday, a return was ordered, on the motion of Mr. Chiozza Money, the Member for North Paddington, "showing for the London County Council, the Corporation of the City of London, the Council of each Metropolitan Borough, the Corporations of the municipal boroughs of Liverpool, Manchester, Birmingham, Leeds, Sheffield, Bristol, Bradford, West Ham, Newcastle-upon-Tyne, Kingston-upon-Hull, Nottingham, Salford, Leicester, Portsmouth, Bolton, Cardiff, Sunderland, Oldham, Croydon, Blackburn, Brighton, Derby, Preston, Norwich, Birkenhead, Gateshead, Plymouth, Halifax, Southampton, South Shields, Burnley, East Ham, Huddersfield, Swansea, Wolverhampton, Stockport, Middlesbrough, Stockton-on-Tees, and Blackpool, and the Corporations of Edinburgh, Glasgow, Dundee, and Aberdeen, the nature and extent and, for each of the last four years for which figures are available, the financial results of reproductive municipal undertakings—including for each undertaking separately a short description thereof, date and terms of original acquisition or establishment or subsequent extension, how managed, capital employed and how obtained, value of the undertaking, capital paid off and outstanding, loan charges, provision for depreciation, gross income and expenditure, net profit or loss, how profit is allocated or loss met, amount of relief or burden to rates, number and salaries of the chief paid officials, number of workpeople, rate of wages paid in chief classes of labour, and the prices charged for the products or services supplied or rendered."

Dissatisfaction at West Bridgford.—The people of West Bridgford are up in arms against an advance which has been made by the Nottingham Corporation in the charge for water supplied in this suburb from 12½ to 25 per cent. in excess of the rate obtaining within the city. A few days ago, a meeting of ratepayers was held, at which it was resolved to protest against this increase, on the ground that it would depreciate property in the district. It was also decided to recommend the West Bridgford Urban District Council to take such preliminary tests as they may think necessary to ascertain the possibility of securing an independent supply of both gas and water. It was stated that the present revenue from West Bridgford for water is £4500, and to this the increase of 12½ per cent. in the charge will, of course, add a further substantial sum.

MISCELLANEOUS NEWS.

PROFIT-SHARING IN GAS-WORKS.

The South Metropolitan Co-Partnership Scheme.

The current number of the "Co-Partnership Journal" of the South Metropolitan Gas Company contains as a frontispiece, as usual at this season, a card conveying the wishes of the Directors for a Happy Christmas by the recipients and all dear to them. The card gives seven views of parts of the Company's works; and in the remaining space the Directors express their appreciation of the loyal assistance rendered by all the true co-partners in the working of the Company. They say they believe co-partnership is the true business principle, and the way to ensure a better distribution of property. They then give the following figures showing the result of seventeen years of co-partnership :—

4998 co-partners now hold £194,232 of stock, at a market value of	£250,559
They have on deposit, at interest.	59,650
Invested in the purchase of houses	24,500
	£334,709

Increase in the year, £39,815.

The number opens with a New Year's address by Sir George Livesey. After wishing all a "Happy New Year," and expressing sympathy with those who have suffered bereavement during the twelve months now closing, he makes the following remarks.

Our co-partnership is a strong young giant in its eighteenth year. The seventeenth distribution was in July last; and as the years pass, each seems better than the last. £43,962 was the amount distributed, and not only was the half put into stock according to the rules, but nearly all the withdrawable followed it—the amount actually invested in stock being £41,683, yielding about 4¼ per cent. interest, which is better than leaving it in the withdrawable account at 3 per cent. interest. Very little was so left, and practically none was withdrawn except the half bonus of the winter men and the men who left the Company's service. . . . The investment in stock of £41,683 (very nearly the whole of the bonus) is a most remarkable and gratifying fact. Eight years ago, the accumulation of £100,000 was thought a great thing. But the total now owned by the employees of the Company is well over £300,000; and it is not too much to hope that in a very few years it may reach half-a-million.

A gradually increasing interest by the employees generally in the welfare of the Company is evident. As their stock and dividends increase, our men realize that more of the Company belongs to them; their future becomes more secure; and naturally they take more interest in their work. Thus both the Company and themselves are benefited. This is as it should be; for to be really successful, and if co-partnership is to last, it must be a benefit to both parties. But let no man think that, being apparently so firmly established, no further care or effort is necessary. No design or plan of man will work itself. Constant intelligent care and effort, with constant vigilance, are necessary to insure continued success in anything; and let me say, again, that the continuance of our co-partnership now depends more on the spirit that animates the workers than on anything else. The Directors have done their part, and can do no more; it is for you to keep it going. I am convinced that the remedy—the only remedy—for the capital and labour difficulty is partnership; and the very word implies that each partner shall do his part honestly, intelligently, and earnestly, or there is no real partnership. Some probably are not true partners. But I prefer to believe that their indifference is due more to want of thought than want of heart. No one can do his best if the highest part of his nature, the thinking part, is not put into his work—thinking how the work can best be done, and how to avoid waste of time and materials. . . . It is impossible to apportion exactly what is due to each partner. Some doubtless get less than they deserve and others get more than is their strict right. But if we all try to act justly—if that is the object we honestly set before us and do our best to attain—as some one has said, "He that does his best does well; angels can do no more." My experience, I am glad to say, has proved to me that when there is a real desire with an earnest effort to do right, to be true and just in all our dealings, men are satisfied and happy in their relations with each other in all the affairs of life.

The Socialists, however, say our co-partnership is quite wrong. They look at the poor circumstances of so many, and at the evils and misery that exist, and say all is due to Capitalism—that is, the private ownership of capital or property of any description. A Socialist M.P. the other day said "Capital—that is the enemy;" and the Socialists say "Collectivism—that is the remedy;" the collective ownership of the land and all the means of production, distribution, and exchange. That means all that every man possesses—your property, whatever it be, as well as mine, and that of all people—would be owned by the State. Everything would be owned generally by everybody, and nothing in particular by anybody. No man could say this or that is mine, not even his children, who would be clothed, fed, educated, controlled, and set to work by the State. How it is to be brought about, I have never heard; but whether this would be true freedom or real slavery is another question. The right to own property is the foundation of liberty; for if a man is not allowed to own what he earns or the product of his labour, he is not a free man. I shall, perhaps, say more on the subject some day; but even if it were desirable or possible, such a change must be the work probably of hundreds of years, and much will happen ere it is accomplished. Men will not readily give up their property.

I agree with the Socialists and others who say property is not fairly divided. For this, all classes are to blame. Employers and owners of property as well as workmen are responsible for the present unsatisfactory division of property. Workmen might have been, and might soon become, owners of a large amount of property, if they did not spend their earnings on drink or worse than waste them on betting.

. . . I am sure that many employers and men in all conditions of life are anxious to help their less fortunate brethren to improve their position; but they do not see how to do it, as we did not until our eyes were opened in 1889. Now it seems to me that by means of co-partnership a better division of property can be brought about in a very short time—practically at once—by our own efforts, and, as many of us think, in a far better way than by collective ownership, which certainly cannot come in our time. Therefore, let all who believe this do all in their power to help to strengthen and to extend the great work of co-partnership. I read in the papers (Dec. 11) that the Nobel Peace Prize is this year given to President Roosevelt for his action in making peace between Russia and Japan. It is a money prize of £7600. The President says there is "no gift he could appreciate more," and adds that he has decided to use the prize to "establish at Washington a permanent Industrial Peace Committee; righteous peace in the industrial world being as important as in the world of nations." That is the opinion of one of the greatest and best of men. I believe this greatly needed "righteous peace in the industrial world" of which the President speaks can only be attained through co-partnership; and all employers and employed who are endeavouring to work that system successfully are not only benefiting themselves, but are doing their part in the great work of securing that "righteous peace in the industrial world" so greatly needed in all lands.

Report of the Labour Co-Partnership Association.

In the annual report of the Labour Co-Partnership Association, which has just been issued, statistics are given relating to co-partnership in gas-works. It is shown (by means of the table that was reproduced in the "JOURNAL" for Oct. 16, p. 190) that for the year ending June last five Companies allotted £53,250 among 7137 workmen as their share of profits, quite over and above the ordinary standard wages. Since the establishment of these schemes—the earliest (that of the South Metropolitan Gas Company) was started in 1899—£396,500 has been divided by these Companies among their employees, who are encouraged to let the profit accumulate instead of withdrawing it in cash. To-day these employees hold £368,500 invested in the stock and on deposit with the Companies.

The report says: "It is expected that the total amount standing to the credit of the 7137 employees in the capital of the Companies in two years will be not far short of £500,000. What this great sum (owned by men most of whom before the adoption of these schemes probably never possessed a penny after they had paid their debts) means in freedom from anxiety, stimulus to careful habits and forethought, and all that goes to add to happiness and strengthen character, it is difficult to over-estimate. On the face of it, it is clear that not only are the individual workmen the gainers, but, as is the case with all genuine progressive steps, the community gains too. One thing, at any rate, these schemes show, and that is that labour co-partnership is practicable in gas companies; and if these alone throughout the country would take the matter up, as five have already done, the improvement in the lives of some tens of thousands of workmen would be great indeed."

QUALITY OF GAS AT HALIFAX.

In a report which Mr. J. Wilkinson, the Gas Engineer at Halifax, has (in consequence of numerous complaints) made on the quality of the gas supply, he explains that, in order to obtain the highest possible value from the coal, the retorts have been worked at very high temperatures, the natural result being a large yield of gas, averaging over 11,300 cubic feet per ton of coal. These high yields cause varying reductions in the candle power, which has to some extent been neutralized by the use of benzol and other hydrocarbon oils as enrichers. The class of coal chiefly used—viz., Black Bed—is such that high heats must be employed if it is desired to obtain the best commercial value from the coal; but if low heats are used in order to obtain a high illuminating gas, it is very probable that a considerable amount of gas will be left in the coke, which, though of inferior illuminating power when used in flat-flame burners, is still of such calorific value as to make it an efficient gas for power purposes, or for lighting when consumed by incandescent burners. When working under the conditions necessary to obtain maximum results, it is quite possible to overdo it; and he is prepared to admit that, in their anxiety to obtain the highest possible returns from the coal, there have been times when the gas has varied in quality, both as regards illuminating power and purity.

Mr. Wilkinson, however, points out that the greater part of the district is supplied from a small holder on the gas-works, having a capacity 376,000 cubic feet only, which is less than 8 per cent. of the maximum daily output. It necessarily follows that in winter this holder is filled and emptied twelve times a day; and the slightest oversight or mishap is immediately detected by consumers. But though some inconvenience may have been felt through variations in illuminating power and purity, he shows that the town has gained financially, by the following comparison between the years 1902-3 (the last year prior to his taking over the management) and 1905-6.

	Cost per 1000 Cubic Feet of Gas Sold.		
	1903.		1906.
Coal, less residuals	4·77d.	..	1·77d.
Carbonizing wages, &c.	3·06	..	2·76
Carburetted water gas	0·90	..	0·04
Purifying, wages, &c.	0·50	..	0·11
Totals	9·23d.	..	4·68d.

On an annual make of 800 million cubic feet, this represents, Mr. Wilkinson says, a saving of over £15,100. It therefore rests entirely with the Committee whether or not the present policy of abstracting everything possible from the coal is to be continued. He thinks the following figures may be of some assistance, when considering the question of reverting to the old system of working, or (say) some intermediate stage.

	Year ending March 31.		
	1903.		1906.
Gas sold per ton of coal and oil equivalent, cubic feet	8,434	..	10,573
Coke saleable per ton of coal, cwt.	6·58	..	8·94
Tar saleable per ton of coal, gallons	10·27	..	12·07
Sulphate of ammonia saleable per ton of coal, lbs.	22·10	..	27·33
Cost of coal per ton	8s. 11·8d.	..	8s. 1·4od.
Amount realized for residuals per ton of coal	5 5·14	..	6 7·96

Mr. Wilkinson says these figures show at a glance the results of the methods of carbonization; and it may be taken that last year's returns reached high-water mark. They were obtained under high pressure, and could not possibly be maintained regularly year by year. In view of the agitation in the district, he suggests that it would probably be best for them to devote their efforts to ensure a supply of (say) 15-candle natural coal gas reaching the utmost limits of their area of supply. The cost of carrying out this would probably represent not less than £2000 per annum.

As to the purity of the gas, Mr. Wilkinson says that oxide only is now used in purification; and he expresses the opinion that variations in the sulphur compounds from 15 to 50 grains would be more liable to cause complaints than would the regular presence of 50 grains of sulphur per 100 cubic feet of gas. He admits that the sulphur is higher than he cares to see it, but explains that the local coals employed are very sulphurous, and that when it was proposed to use a better coal the Committee did not care to incur the additional expense.

PRESENTATION TO THE CHAIRMAN OF THE DOVER GAS COMPANY.

Last Wednesday evening, the members of the reading and recreation room at the Dover Gas-Works assembled to celebrate the nineteenth anniversary of the opening of the premises. The room was instituted, it may be remembered, for the purpose of affording the men an opportunity of enjoying rational amusement free from the temptations which they might meet with elsewhere; and though it was regarded with a good deal of doubt at the commencement, its career in a thoroughly flourishing condition proves the necessity for its existence, and the support given by the men employed at the works is sufficient guarantee of its popularity. The chair was occupied by the President, Mr. R. Herring, the Company's Resident Engineer, who was supported by Mr. Willsher Mannering, Chairman of the Company, Mr. J. Robson, a Director, and Mr. E. C. Herring.

In the course of the evening, the President said he had a most pleasing duty to perform. Looking round, he could see among the men one with a record of fifty years' service, while others had been with the Company forty years. When they found men with records like this, it went without saying that the Board of Directors, as represented by their guest, Mr. Willsher Mannering, must have been at some pains to make the condition of employment as favourable as possible, so as to retain their services. As regards the room in which they were gathered, Mr. Mannering and his colleagues were mainly instrumental in starting the movement; and he (Mr. Herring) was more than pleased after nineteen years to be able to say that they had not been wrong in their ideas when they decided to erect a recreation-room, for the use of the men employed at the Buckland Gas-Works. The conditions of employment which now obtained on the works were much to the advantage of the men, who must all be fully conscious of what Mr. Mannering had done; and he (Mr. Herring) was going to ask him to accept an illuminated address as a small memento of their deep appreciation of his kindness and consideration.

The address, which was a beautiful specimen of work, with deep gold frame, read as follows:—

Presented to Willsher Mannering, Esq., Chairman of the Dover Gas Company, by the Committee and Members of the Reading and Recreation Room, Gas-Works, Dover.

As a memento in connection with the Institution established 12th December, 1887, we ask your acceptance of this address. Personally and financially you have always been our best friend, a very liberal subscriber, and a willing adviser, also honouring us with your presence at the anniversary meetings and concerts. We know your desire is to promote prosperity and contentment amongst the workmen; and to further this, you encourage healthy recreation and amusements as provided in this room. Please feel assured that we all sincerely and heartily appreciate your great kindness and thank you for helping us. Our united wish is that you may be blessed with good health, and long remain Chairman of this successful Company. We in return pledge ourselves to do our duty, hoping thereby to assist you in promoting the continued prosperity of the Dover Gas Company.

We remain, dear Sir, yours faithfully, Raphael Herring, President; E. C. Herring, Vice-President; Chairman of Committee, T. Pybus; Honorary Secretary, H. Harman. Committee: A. Pierce, A. Bonnage, D. Sutherland, S. Marsh, R. Goldsack; Auditors, C. Blackman, J. Valentine; Steward, J. Dowle. 12th December, 1906.

In accepting the gift, Mr. Mannering said it had been his policy, ever since he had been Chairman, to do his duty both to the Company and to those in their employ. It was gratifying to him to know that the recreation-room had been a success; and he hoped the men had spent many pleasant and social hours there. He fully appreciated the services they had rendered; and he must acknowledge that the success of the Company was, and must always be, greatly due to their exertions. In conclusion, he thanked them heartily for the kindness they had shown him that evening, which he assured them he should never forget. He had attended their anniversaries for nineteen years, and had had no greater pleasure than to be with them on these occasions.

Mr. Mannering then proposed "The President," and expressed the hope that Mr. Herring would be long spared to manage the works in the more than satisfactory way he had hitherto done. Mr. Herring, in acknowledging the toast, said if the men did their duty they would help him; and in helping him they would also be helping the Company to maintain its position. He hoped that as long as he was associated with them they would render him that ready help which they had hitherto given him. He also mentioned that no less a sum than £5000 had passed through his hands as Treasurer of the various funds—a sum which, had it not been for that institution, would have simply gone without benefiting them in the least.

Other toasts followed, and a very enjoyable evening was brought to a close by the singing of "The King."

THE MANAGEMENT OF THE BURTON GAS-WORKS.

A Tribute to the Late Mr. Ramsden.

At a Special Meeting of the Burton-upon-Trent Town Council last Wednesday, the Mayor (Alderman Lowe) said that since their last meeting an old and trusted member of their staff had passed away; and he should like to take this early opportunity of expressing, on behalf of the Council and of himself, their deep sympathy with Mrs. Ramsden in the great sorrow she was passing through, and the trials she had undergone during the last two years, as well as with the other members of the family, at the grievous loss they had sustained in the death of Mr. Ramsden. At the same time, he wished to express his appreciation of Mr. Ramsden, not only as an honourable and efficient servant of the Corporation, but as a man of high and lofty character. The Vicar of Burton well said at the graveside that Mr. Ramsden, during the last two years, had displayed courage and patience of a high quality, such as he had never met with in his life. His fortitude would always be remembered by them, and the memory would inspire them to endurance in the time of difficulty which must come to them all sooner or later. Alderman Thompson moved that the Council's sympathy and condolence be duly recorded and forwarded to Mrs. Ramsden and the family. He said that they all felt great sorrow, for the late Mr. Ramsden had been associated with them in their work. He had done very much for the Council and the ratepayers; and some of those who were very intimately associated with him would like to make a distinct mark of appreciation of his life and work among them. Mr. Austin said he had, on occasions, been the intermediary by which the employees of the gas-works had approached Mr. Ramsden; and, on their behalf, he expressed great sympathy with the widow and family. Mr. Ramsden had always given the kindest consideration to any representations made to him; and the employees felt that they had lost a very courteous Manager. A vote of condolence was passed in silence.

YOKOHAMA GAS-WORKS.

A Short History.

The gas-works of the City of Yokohama were the first of the kind in Japan. Mr. Kaemon Takashima, together with eight other people, started the design in 1870, and commenced the work in September, 1872, which was the first occasion gas was consumed in the country.

In June, 1875, the works were bought for 250,000 yen by the First Large Division of the city, and became a municipal property; the name being changed to the "Gas Kiyoku." At that time the plant consisted of eight benches, each containing five horizontal retorts, two vertical boilers of 2½ H.P. and 60 lbs. working pressure, an exhauster capable of exhausting 15,000 cubic feet per 24 hours, a 432 lineal feet tubular condenser of 8 inches diameter, two tower scrubbers 15 feet high, four purifiers with a surface area of 40 square feet for purifying the gas, a station meter with a capacity of 8000 cubic feet per 24 hours, and a single-lift gasholder with a capacity of 30,000 cubic feet. The plant was designed to produce 80,000 cubic feet of gas per day. With regard to the main-pipes laid in the streets, the largest were 8 inches in diameter, and the total length was 79,508 feet.

In September, 1879, the First Large Division of the city transferred the gas-works to the Honcho Association. When the City Law was promulgated, the Yokohama City bought the gas-works from the Honcho Association for 120,000 yen. This was in April, 1892.

In 1895, an extension of the works was made which was the first thing of the kind undertaken by the city. A single-lift gasholder of a capacity of 50,000 cubic feet was built, the retort-benches were repaired, the pipes in the streets were extended, and the principal mains enlarged to 10 inches. Since then the demand for gas has shown a remarkable increase year by year.

In 1899 and 1900, a second extension was made. There were erected an inclined retort-house, with three benches of seven retorts, two scrubbers 31 feet high, and 6 ft. 3 in. diameter, three purifiers of 100 square feet surface area, two Beale rotary exhausters each capable of exhausting 15,000 cubic feet per day, two gas-engines to drive same, and a two-lift telescopic gasholder of a capacity of 90,000 cubic feet. The plant at the time when the second extension was made consisted of both horizontal and inclined retorts. The horizontal retort-benches were eight in number, each having seven ⌂-shaped retorts 22 in. by 13 in. by 8 ft. 6 in. long, worked by manual labour. The inclined-retort benches were three in number, each having seven ⌂-shaped retorts 22 in. by 16 in. by 20 ft. long, worked by machinery. For condensing and purifying the gas, there was used a circular atmospheric condenser 23 ft. 6 in. high, a tubular condenser 8 inches diameter, with a lineal length of 432 feet, a multitubular condenser 15 feet high by 5 feet diameter, and a twin tower-scrubber 31 feet high and 6 ft. 3 in. diameter. There were three purifiers each of 100 square feet surface area; and there was a station meter with a capacity of

CARBURETTED WATER-GAS APPARATUS

Merrifield—Westcott—Pearson Patents.

The Economical Gas Apparatus Construction Co., Ld.

W. H. PEARSON, Chairman.
W. H. PEARSON, Junr., Deputy-Chairman.
J. T. WESTCOTT, Manager.
L. L. MERRIFIELD, M.Inst.M.E., Engineer.

London Offices: 19, ABINGDON STREET, WESTMINSTER, S.W.
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CARBURETTED WATER-GAS ENGINEERS.

The above Company have erected since 1893, or are now erecting, their Universal Type of Carburetted Water-Gas Plant at the following Gas-Works:—

	Cub. Ft. Daily.		Cub. Ft. Daily.		Cub. Ft. Daily.
Blackburn	1,250,000	Winnipeg, Man.	500,000	Malton	150,000
Windsor St. Works, Birmingham	2,000,000	Colchester (Second Contract)	300,000	Smethwick	500,000
Saltley Works, Birmingham	2,000,000	York	750,000	Gravesend	300,000
Colchester	300,000	Rochester	500,000	Pernambuco, Brazil	125,000
Birkenhead	2,250,000	Kingston, Ont.	300,000	Duluth, (Second Contract)	300,000
Devizes	120,000	Crystal Palace District	2,000,000	Leicester (Second Contract)	1,000,000
Saltley, Birmingham (Second Contract)	2,000,000	Duluth, Minn.	300,000	Newport (Second Contract)	250,000
Windsor St., Birmingham (Second Contract)	2,000,000	Caterham	150,000	Brockville	250,000
Halifax	1,000,000	Leicester	2,000,000	Toronto (Third Contract)	750,000
Toronto	250,000	Enschede, Holland	150,000	Montreal, Ont. (Second Con.)	1,800,000
Ottawa	250,000	Buenos Ayres (River Plate Co.)	700,000	Toronto (Fourth Contract)	1,000,000
Lindsay (Remodelled)	125,000	Burnley	1,500,000	Hamilton, Ont.	400,000
Montreal	500,000	Kingston-on-Thames	1,750,000	Rochester (Third Contract)	1,600,000
Toronto (2nd Cont., Remodelled)	2,000,000	Accrington	500,000	Leeds (Second Contract)	900,000
Belleville	250,000	Tonbridge	300,000	Buenos Ayres (Primitiva Co.)	1,200,000
Ottawa (Second Contract)	250,000	Stretford	500,000	Buenos Ayres (New Co.)	1,200,000
Brantford (Remodelled)	200,000	Oldbury	300,000	Christchurch, N.Z.	300,000
St. Catherines (Remodelled)	250,000	Todmorden	500,000	Rochdale	1,600,000
Kingston, Pa.	125,000	Saltley, Birmingham (Third Contract)	2,000,000	St. John's, Newfoundland	250,000
Peterborough, Ont.	250,000	York (Second Contract)	750,000	Brantford (Second Contract)	400,000
Wilkesbarre, Pa.	750,000	Rochester (Second Contract)	500,000	Smethwick (Second Contract)	500,000
St. Catherines (Second Cont.)	250,000	Newport (Mon.)	250,000	Pontypridd	250,000
Buffalo, N.Y.	2,000,000	Tokio, Japan	1,000,000	Montreal (Third Contract)	1,800,000
		Newcastle-on-Tyne	1,800,000	Guelph, Ont.	350,000
		Leeds	1,800,000	Buenos Ayres (River Plate Co.) Second Contract	750,000
				Belgrano (River Plate Co)	500,000
				Quebec	250,000

And, in addition, COAL GAS PLANTS at NELSON, B.C., CHATHAM, BERLIN, NAPANEE, OWEN SOUND, CALGARY, and WINNIPEG.

10,000 cubic feet gas per hour. There were two single-lift gasholders of 30,000 and 50,000 cubic feet capacity respectively; and a two-lift telescopic holder of a capacity of 90,000 cubic feet. The total storage amounted to 170,000 cubic feet. There was a regulator of 10 inches diameter, in order to regulate the pressure of gas in the streets.

About the end of 1903, a thorough investigation of the gas-works in the past and the prospects of the future was made; and as the result, it was found there was much room for extension. Assuming that the demand for gas would increase yearly at the rate of about 10 per cent., on an average, a scheme was drawn out to extend the works so as to meet the demand for the next ten years. This is the third extension of the works. Some of the plant was enlarged; and the old apparatus was as much as possible repaired and utilized, and the design modified in order to increase the output as much as possible.

In the year 1904, a two-lift telescopic gasholder of 300,000 cubic feet capacity, a station meter to register 10,000 cubic feet of gas per hour, and a 14-inch station-governor were erected. An annular condenser 27 feet high, 5 feet external diameter, and 3 ft. 5 in. internal diameter, connected to the inclined retort-house, and two annular condensers 23 ft. 6 in. high, 3 ft. 6 in. external diameter, and 2 ft. 6 in. internal diameter connected to the horizontal retort-house, were installed at the same time.

In 1905, designs were made to erect a washer-scrubber to pass 500,000 cubic feet per 24 hours, a washer to pass 500,000 cubic feet per 24 hours, and two gas-engines of 10-H.P. to run these and the exhausters; and it was also decided to thoroughly repair the main-pipes in the streets. The present 10-inch pipes will be changed to 14 and 12 inch ones; the 10-inch pipes will be extended; and a portion of the present 2 and 3 inch pipes will be changed to 5 and 4 inch ones. Thus the output of gas to the city will be increased, and the pressure will be more uniform.

The business has been increasing year by year. Particularly since 1903, many improvements have been made in the organization and management, the result of which has been that the increased demand has been accompanied by an increase of profit which has broken all records.

New Joint-Stock Companies.—The Seascale Gas Company, Limited, has been registered with a capital of £5000, in £1 shares, for the purpose indicated by the title. The British Gas Furnace and Tool Company, Limited, has been registered, without Articles of Association, with a capital of £1000, in £1 shares.

Record Gas Consumption at Rochdale.—The gas consumed at Rochdale last Tuesday week exceeded 3 million cubic feet, which was a record for one day. This large demand was caused by a dense fog during the daytime. The Manager (Mr. T. B. Ball) has reported to the Gas Committee that recent high winds were responsible for the destruction of about three gross of incandescent mantles in the street-lamps.

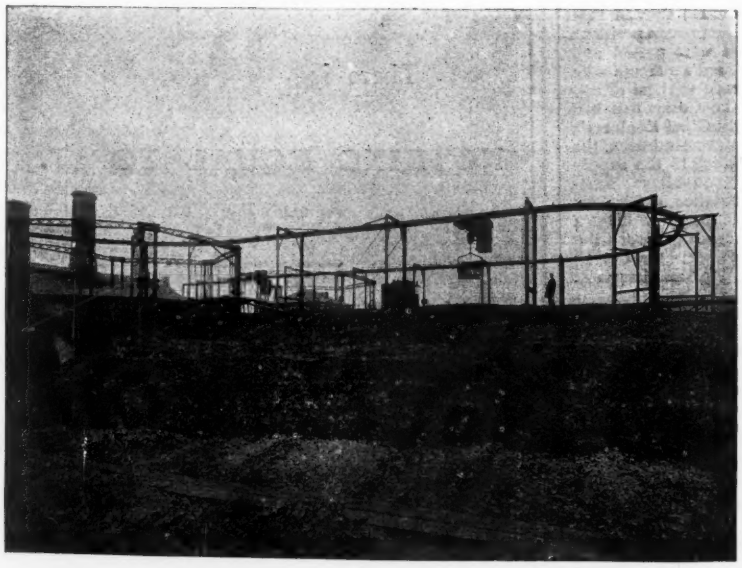
FAILURE OF THE ELECTRIC LIGHT IN MARYLEBONE.

Last Wednesday evening, a failure of the electric light in part of the district supplied by the Marylebone Borough Council caused much confusion and dislocation of trade. Christmas shopping was in full swing in Oxford Street, the north side of which was practically in darkness for twenty minutes. All day fog had been the source of much inconvenience, and artificial light was resorted to in the streets and shops. Great crowds were making purchases, and just before six, when business and traffic had reached the culminating point, the electric street-lamps went out, and the sole light afforded was that of the gas-lamps, which are being superseded. With the exception of a few establishments which have their own electric lighting plant, all the shops on the north side of the street were plunged in almost complete darkness. Fortunately several had still a supply of gas, and all available jets were immediately lit. Other establishments had a great number of oil-lamps and candles. Meanwhile, orders were issued to close the doors. At a quarter-past six the light reappeared, not with such brilliancy as before, but sufficient for customers in the shops to complete their purchases. The official explanation of the occurrence was that part of the machinery got out of gear at the generating station, with the result that the pressure was reduced.

SWADLINCOTE GAS SUPPLY.

At the Meeting of the Swadlincote Urban District Council early in June, the abstract of accounts of the gas undertaking for the year ending the 31st of March was presented. It showed a revenue of £11,367, and an expenditure of £6640—leaving £4727 to go to the profit and loss account, on which there was a net profit of £971. The accounts were criticized by Mr. Howard, who said he failed to see where the profit shown came from, as there was an overdraft of £2200 at the bank. After some discussion, it was decided to engage an expert to examine the accounts, in order to ascertain whether or not a profit had been made. The gentleman selected was Alderman Hart, of Derby, whose report came before the Council a few days ago. He found the total expenditure on the trading account for the period in question, including £1081 principal repaid and £1971 interest on loans, was £9121. The net revenue from the sale of gas, with meter-rents, was £7054; residuals produced £1457; the sale of fittings and other items made up a total of £10,055—leaving a balance of £934, after meeting the expenditure. After an adjustment of stocks, he brought out a balance of profit (to be devoted to the free fittings system) of £971. Mr. Beaumont, in moving the adoption of the report of the Lighting Committee, said that there was not much difference between the

TEMPERLEY TRANSPORTERS



Temperley Transporter Plant for Storing Coke at the Paisley Corporation Gas-Works. The same plant is used for screening and loading into delivery carts.

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original balance-sheet and Alderman Hart's account. Mr. Howard took exception to this statement, and contended that the profit made last year was only £3 11s., which proved that the Council were selling gas at ½d. per 1000 cubic feet less than cost price. He moved that Alderman Hart should be asked to meet the Council, and explain the details of his report; and this was eventually agreed to.

METROPOLITAN WATER BOARD.

A Special Meeting of the Board was held on Friday, the 14th inst., for the consideration of a report of the Law and Parliamentary Committee, dealing with the Board's Various Powers Bill to be introduced next session. The Bill has been prepared to give effect to the following resolutions passed by the Board: "That application should be made in the next session of Parliament for (1) all the powers given to local authorities under the Public Health Act, 1875, with respect to the laying of pipes; (2) power to call upon other bodies to alter the position of any pipes, wires, drains, &c., similar to the powers conferred under the General Electric Lighting Acts, 1882 and 1888, giving power to the electric lighting authorities for the alteration of any pipes of the Board; (3) the adoption of a uniform form of notice of intention to open streets, somewhat similar to that scheduled to the East London Act, 1886, for use throughout the whole area; and (4) powers to prevent persons from tampering with sluice-valves and other apparatus on service-mains, and thus shutting off the water." "That application should also be made for powers for the following purposes: (1) Construction of a main from the Rammey Marsh well; (2) construction of a tunnel under the Thames at Twickenham; (3) acquisition of certain land and easements along the line of the proposed 30-inch main from Hampton to Hanwell; (4) acquisition of certain land along the line of the proposed new main from Ditton to Norwood, to be the subject of a further report to the Board; and (5) extension of the time for the construction of works authorized by the Southwark and Vauxhall Water Company's Act, 1898, and by the Lambeth Water-Works Act, 1900." On the recommendation of the Committee, the Bill was approved, subject to such amendments as the Law and Parliamentary Committee might find necessary in the Board's interests.

The ordinary fortnightly meeting of the Board was held last Thursday, when the Works and Stores Committee reported that they had had before them the question of the terms and conditions of employment of the workmen in the service of the Board, with a view, if possible, of securing uniformity. They found the matter one of extreme difficulty, owing to the greatly varying conditions which existed in the areas of the late Water Companies. In this connection, too, it was necessary to take into consideration the question of the desirability and practicability of adopting Trade Union terms and conditions. The Committee invited the men in the various districts to elect representatives to confer with certain members of the Board in order that they might have the views of the men themselves. A conference accordingly took place on the 13th ult. The question which acquired special prominence was as to whether the Board should endeavour to bring all the men in their employ under Trade Union terms and conditions, or whether the present terms should continue. Upon this issue it was decided to take a ballot of the men; the result being that 2888 were in favour of continuing the existing conditions of employment, and 49 voted for Trade Union terms. The report was adopted. The Committee also reported that a letter had been received from the London County Council in regard to the supply of water on the occasion of a fire which took place at Victoria Park Wharf on the 21st of September last, and in which it was stated that the extent of damage caused by the fire was due to the inadequate supply of water available for its extinction. A report from the Chief Engineer of the Board (Mr. W. B. Bryan, M.Inst.C.E.) showed that the hydrants in the neighbourhood were fixed in their present positions by order of the Council or their predecessors, and were passed and paid for by them without any complaint. The Board's officers who attended the fire stated that no complaint was made to them of any deficiency of water by the officers in charge. The Committee had accordingly given instructions for the substance of the Chief Engineer's report to be communicated to the Council. At the same meeting, the Committee presented the following information relating to the supply of water last month: Average daily supply, 214,450,000 gallons; number of houses supplied, 1,057,125; estimated population, 6,867,677; mean supply per head per day, 31·2 gallons, compared with 30·4 gallons in November, 1905; water in store in impounding reservoirs, 6,412,000,000 gallons, against 5,680,020,000 gallons this time last year; number of new supplies (including trade) laid on, 1335; and length of mains laid, 13,995 yards.

Reductions in Price.—The Directors of the Leighton Buzzard Gas Company have decided to reduce the price of gas 2d. per 1000 cubic feet as from October last. The attention of users of gas for power and manufacturing purposes in the district of the Wandsworth and Putney Gas Company is being directed to the revised terms of discount which will come into force on the 1st prox. The present price of 2s. will be subject to a discount of 15 per cent.—making the net cost less than 1s. 8½d. per 1000 cubic feet. The discount will be applicable to gas used for engines, furnaces, forges, blast-burners, washers for laundries, &c.

Gas Explosion at Bradford.—By a gas explosion which occurred in his house, Mr. Percival Hutchinson, the brother of the Bradford City Coroner, was last week somewhat badly burnt about his hands and arms. During the night, he noticed a strong smell of gas, and went downstairs, without striking a light. In the passage the smell of gas was very strong; and when Mr. Hutchinson opened the door of the dining-room, which is at the back of the house, and in which a small light was kept burning, there was at once a loud explosion. Mr. Hutchinson was blown against an inner door in the passage, which was smashed to pieces; while the partition work in the passage was blown down. In the dining-room, the furniture and ornaments were severely damaged; and other injury to property was caused.

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NEW YORK WATER SUPPLY.

The First Contract for the Catskill Aqueduct.

We learn from "Engineering Record" that plans and specifications have been completed for the construction of portions of the Peekskill division of the proposed Catskill aqueduct, aggregating about 11 miles in length, forming part of the works for providing an additional water supply for New York, and that tenders for the work have been sent in to the Board of Water Supply. The award of the contract will mark the beginning of the greatest public water-works yet undertaken. The portions of the aqueduct contemplated to be built at first are located largely in the Croton watershed, between a point nearly east of Peekskill, and another close to, and east of, Cold Spring. This part of the aqueduct therefore lies nearly adjacent to the Hudson River crossing, which, it is understood, will be at the highlands immediately north of West Point. There are a number of reasons why this part of the work is first undertaken. It is to some extent the easiest to put under contract in a comparatively short time. The aqueduct between the limits named is mostly "cut-and-cover" work, though a considerable section of the line is in tunnel. The features of such work permitted an early completion of plans and specifications, and thus enabled it to be put in hand in much less time than other parts of the undertaking, in connection with which there are engineering problems of extraordinary difficulty and unusual magnitude. Furthermore, it is probably recognized by the Board of Water Supply that the city may suffer inconvenience at least approaching a water famine before relief from the Catskill watersheds can be attained. Under these conditions, it will be imperative for the city to secure water temporarily from any source which it is feasible to reach. It is not impossible—if, indeed, it is not probable—that it may be pressingly necessary to secure the water of Peekskill Creek for at least a short period of time, to relieve an exigency of this kind. The construction of the southern portions of the aqueduct covered by the contract will enable the waters of this stream to be turned into the aqueduct by pumping if necessary, and thus reinforce the Croton supply. This possible source of relief has already been thoroughly discussed. While the flow of Peekskill Creek is not of great volume, it is sufficient to make it of no small value under conditions of drought which may easily occur. The construction of a "cut-and-cover" aqueduct affording a channel for the flow of water 17 ft. 6 in. wide and 17 ft. high is out of the ordinary way. While it might at first seem that the merits of reinforced concrete would best satisfy the requirements of such work, our contemporary thinks it is more prudent to give this great concrete channel such dimensions that it shall possess all the needed strength and stability for its duties without steel reinforcement. At the same time, use is made of steel where it may be of real benefit to the work, as in the case of syphons and other special structures.

Probably there is no part of the entire specifications for this work which shows more clearly the advance in concrete construction than that relating to the proportions of cement, sand, and broken stone or gravel. The value of the finer portions of the product of the crusher as sand is recognized, and its use is fully contemplated; but no rigid proportions of mixture are prescribed. The nearest approach to exactness is found in a section where it says that generally the "concrete will be mixed approximately in the proportions of 1 volume of cement to 8 volumes of sand or screenings, and gravel or crushed stone; the sand or screenings and the ballast being measured separately." It is clearly the purpose to pursue the rational procedure of determining the mixture that will make the most nearly impermeable concrete with economical proportions, providing sufficient cement to fill all the voids and perhaps a little more of the remaining aggregate. The specifications covering rock tunnel work are equally reasonable with those for concrete. A limiting line is carefully defined and prescribed within which excavated material will be paid for and outside of which the contractor is essentially advised that he must excavate at his own cost.

Incandescent Gas v. Electric Light for Schools.

At the Meeting of the Education Committee of the London County Council last Wednesday, a report was submitted from the Buildings and Attendance Committee as to the relative advantages of gas and electric light for the Council's schools. The Committee on Oct. 24 decided to forward to the Finance Committee the information contained in the report with reference to the comparative estimated cost of lighting schools by gas and electricity, and the expenditure incurred upon incandescent mantles and gas-fittings, together with copies of detailed statements submitted in manuscript. The Finance Committee stated that they were of opinion that, in view of the question raised by Mr. Cobb upon the latter point at the meeting of the Council in May last, the substance of the information should be reported to the Council, in order that the members might be made fully acquainted with the arrangements in force for securing economy in the distribution and use of mantles and fittings. After carefully considering the matter, however, the Committee arrived at the conclusion that no useful purpose could be served by adopting the suggestion. The detailed statements which had been prepared, while containing useful information upon the purely financial aspect of the question, would not, in their opinion, provide suitable material for a general discussion as to the merits of the two systems. It was difficult in many cases to prepare a comparative statement, because of the variation in the number of dark days and of the evenings when the schools were used for several purposes, as well as for other reasons. They therefore recommended that a memorandum should be sent to the Finance Committee embodying the points contained in the foregoing report; and his was agreed to.

At a very early hour in the morning last Saturday week, electric light consumers at Rochdale were deprived of this commodity for a time, owing to the switchboard at the Town Hall having caught fire. This was not at an hour at which most people would be inconvenienced; but the newspaper offices suffered, as well as those who were present at a volunteers' ball.

RADIATOR PICTURES, No. 10.

Mansion House, Doncaster,

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Wright's "St. Andrew" Gas-Heated Steam Radiators

are installed.

CORPORATION GAS-WORKS,
DONCASTER.
30th October, 1906.

Messrs. J. Wright & Co.,
Birmingham.

Dear Sirs,

In reply to your enquiry, I am glad to say that the Gas-Heated Steam Radiators in use in the Mansion House are satisfactory, and maintain an equable temperature.

Yours truly,

(Signed) ROBT. WATSON.

WRIGHTS THE RADIATOR PEOPLE.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

Lord Ardwall had before him in the Court of Session yesterday the action by James Muir and Son, Limited, against the Edinburgh and Leith Gas Commissioners, in respect of the pollution of one of the wells in the brewery. His Lordship has been appointed to take further proof in the case, and he had fixed Jan. 8 as the day upon which it was to begin. Yesterday, however, Counsel for the Gas Commissioners informed his Lordship that they would be unable to lead evidence then, because they have not yet completed the investigation which they are making into the strata in the ground. They were desirous of driving a mine to the extremity of the gas-works, which would not be completed by the time named; and, accordingly, a postponement of the proof was asked for. Counsel for the pursuers expressed a strong desire that everything should be done to forward the case. They were desirous that a decision might be given during this session. Lord Ardwall said the first day he could give them was March 5, which drew from pursuers' Counsel the remark that this would render a decision this session impossible. The case, he said, had been a frightfully expensive one for the pursuers, because every time the defenders sent an expert to examine the wells, they had to send one of their skilled witnesses too. He understood that the expenses already amounted to about £2000. Lord Ardwall said he would reserve March 5, 6, and 7 for the proof; but he would make the adjournment *sine die*, and in the event of the defenders concluding their investigations sooner, it would be open to either party to move for proof to be taken earlier. Lord Ardwall's decision, which is under review, was given in June, 1905.

We have long been familiar with railway trains lighted by gas; but it may not be generally known that the best-lighted trains which run in Scotland are some upon the railway from King's Cross to Aberdeen. These are lighted by inverted incandescent gas-burners, both in the compartments and in the corridors. It is almost needless to say that the lighting is perfect. So far as I have been able to learn, there is next to no trouble with the mantles.

The other evening there was an explosion of gas in a railway van in Queen Street Station, Glasgow. Oil gas for lighting trains is made at College Station, and is conveyed to Queen Street, where the vehicles are charged. This process was being carried out when the explosion occurred. The escaping gas was ignited by the explosion. The Fire Brigade were sent for; but the station officials had the fire extinguished before their arrival. It is supposed that a hand-lamp being carried past the van was the cause of the accident.

The Scottish Section of the Electrical Contractors' Association (Incorporated) held a dinner in Edinburgh on Monday, over which Mr. W. Finlay, the Chairman of the East of Scotland branch, presided. In proposing the toast of "The Corporations of Edinburgh and Leith," the Chairman went out of his way to refer to a circular which, he said, had lately been issued by the Edinburgh and Leith Gas Commissioners. So far as he could see, the duty of the Commissioners was to make as good gas, and sell it at as moderate a price, as possible. He had no doubt the Gas Commissioners felt the competition that the electric light had given them, and that their consumption might ultimately be considerably reduced by it; but this did not warrant them in taking on business which they were not entitled to do, and which they were not suited to undertake. He thought the members should raise their voice in strong protest against the action of the Gas Commissioners in doing work at cost price, and possibly under it. This outburst was followed by a suggestion, from another speaker, that a co-operative association, or co-operative show-room, should be instituted, which is the thing that the Gas Commissioners have started, and for which they were rated by the Chairman. Of course, the two standpoints are different. The electrical contractors want cheap goods for themselves, but do not appear to see any virtue in the public getting gas-fittings at low prices.

The Town Council of Kirkcaldy have obtained a report from an expert upon the lighting of the streets. There are 33¼ miles of streets, roads, lanes, and squares in the burgh. Of these, 29 miles are lighted by gas-lamps and 4½ miles by electric arc lamps. There are 1024 gas-lamps and 104 electric lamps. The sums charged against the Lighting Department in the past year were: For gas, £1604; and for electricity, £1248. The candle power of the gas-lamps per mile is stated as 1306, and of the electric lamps as 15,430.

The subject of street lighting is exercising the minds of the town councillors of Cowdenbeath. At present electricity is the lighting medium, generated by plant belonging to the Council. Owing to the increase of the town, the plant has become too small for the work, and an extension of some sort is necessary. A motion has been given notice of in the Council that gas be introduced; and a communication has been received from the Manager of the Fife Electric Power Company, offering to supply electricity in bulk at about 2d. per unit—the minimum yearly payment to be not less than £150. The subject is to be discussed at the next meeting of the Council.

In the Second Division of the Court of Session on Tuesday, intimation was ordered of a petition by Wm. Glass and others, asking for an order for the winding-up of the Granton Gaslight Company, Limited. The Company was formed in 1864. It is a small concern, with only £700 of capital. It has ceased to manufacture gas, and the works and plant, which are the only assets, are falling into disrepair. There are no debts except feu-duty for the past two years, and a sum of £30, part of the Company's coal account, which it seems was paid by the Chairman.

Last Wednesday afternoon, as a train was leaving Chorley Station, there was a loud explosion, followed by a burst of flame under the engine. It was discovered that the gas-main, which passes under the line at a level crossing, had broken, and that the escaping gas had been ignited by a burning cinder from the fire-box of the engine. The force of the explosion damaged the crossing-gates, and rendered them unworkable; but the flames were soon got under.

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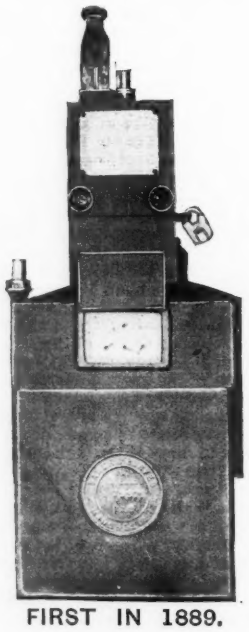
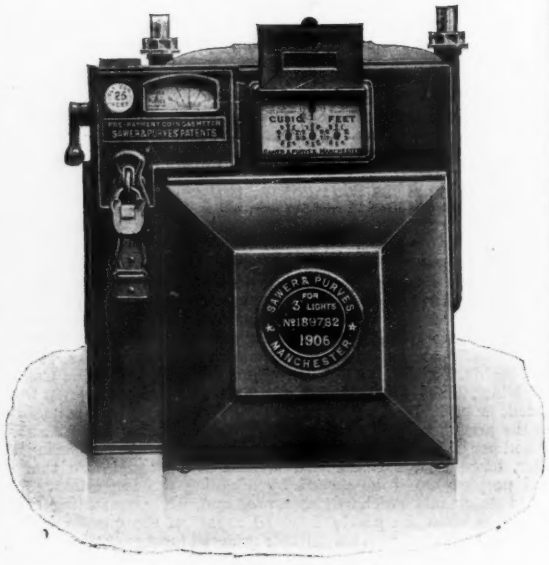


FIRST IN 1889.



FOREMOST 1906.

SAWER & PURVES,

MANCHESTER & NOTTINGHAM.

CURRENT SALES OF GAS PRODUCTS.

Week ending Dec. 22.

Business in the London market has been a little quiet during the week, but prices, on the whole, are firm. The very considerable orders placed for pitch, for delivery between now and June next, have put the London makers in a much firmer position; in fact, they have little more left for sale this season. Pitch, therefore, should not recede further in this market. Benzol, 90 per cent., is in strong demand; and it is rumoured that 1s. 2d. per gallon net has been paid for delivery over the next two or three months. Creosote also is strong; and for export 2¼d. to 2⅜d. per gallon naked at sellers' works can be obtained. 60° crude carbolic is practically without change, but is said to be, if anything, slightly weaker. Sulphate of ammonia shows no improvement, and, in fact, prices are a little lower on the week.

LIVERPOOL, *Dec.* 21.

Sulphate of Ammonia.

Depression still hangs over the market, and prices are again easier at all points. While makers are anxious to clear out their bins as far as possible before the end of the year, buyers seem to have covered their December requirements, and to be indifferent about anything beyond that. Consequently the closing quotations are £11 12s. 6d. per ton f.o.b. Hull, £11 15s. per ton f.o.b. Liverpool, and £11 17s. 6d. per ton f.o.b. Leith. There is nothing doing in the forward position.

Nitrate of Soda.

This article is weak for spot and near delivery, and the price of 95 per cent. is down to 11s. per cwt.—11s. 9d. being required for refined.

LONDON, *Dec.* 21.

Tar Products.

There has been little of importance in the market during the past week. Pitch is quiet, but there is not much alteration in prices. Business has been done on the east coast at 25s. for delivery over the first six months of next year; while for prompt delivery in London, 25s. 6d. would be accepted. On the west coast, Manchester pitch has been sold at 25s. for prompt, while a firm offer of a further quantity for January at 25s. 3d. did not result in business, and very low figures are reported to have been accepted at other ports on the west coast. There is little business doing on the Continent. Buyers do not care to entertain any quantities except for the end of next year, for which period dealers are unwilling to quote at existing figures. There is no change in the market for creosote; but this article is firm, and there is little offering—makers being well sold, and not caring to do any business until after the New Year. Carbolic acid is rather firmer; 1s. 8¾d. having been paid on the east coast for January-June delivery, while most of the makers ask 1s. 9d. over the same period. Crystals are reported to be rather firmer, and business is stated to have been done at improved figures. Benzol 90 per cent. is scarce for prompt delivery, and good prices have been paid, while for forward, makers are evidently well sold, and do not appear at all anxious to quote. 50-90 per cent. is quiet; and consumers do not seem very anxious to buy, as they will only offer very low prices over the first six months of next year. There is no change in the market for toluol; but a small quantity is reported to have been sold in London at 1s. 2d. per gallon. Solvent naphtha continues very firm, and in London is still hard to obtain for prompt delivery; while good prices have been paid over the first six months of next year, both in London and on the east coast.

The average values during the week were: Tar, 15s. to 19s. Pitch, London, 25s. 6d. to 26s.; east coast, 25s.; west coast, 25s. Benzol, 90 per cent., 1s. to 1s. 1d.; 50-90 per cent., 11½d. to 1s. Toluol, 1s. 1½d. to 1s. 2d. Crude naphtha, 4⅜d. to 5½d.; solvent naphtha, 1s. 3d. to 1s. 5d.; heavy naphtha, 1s. 3d. to 1s. 5d. Creosote, London, 2½d. to 2¾d.; North, 1⅞d. to 2d. Heavy oils, 2½d. Carbolic acid, 60 per cent., 1s. 8⅜d. to 1s. 9d. Naphthalene, £4 10s. to £9 10s.; salts, 32s. 6d. to 35s. Anthracene, "A" quality, 1⅛d. to 1⅝d.

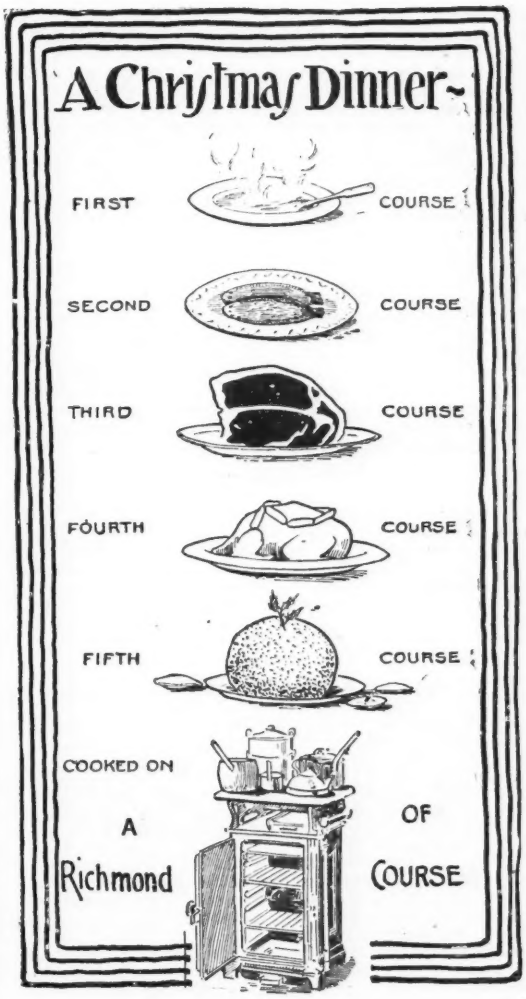
Sulphate of Ammonia.

The market closes weak, and prices have a downward tendency. The principal London Companies maintain their quotation at £12 5s.; but business has been done in other makes on Beckton terms at considerably under this figure—it being reported that equal to £11 12s. 6d. has been accepted for prompt delivery. In both Hull and Liverpool, business has been done at from £11 15s. to £11 17s. 6d., according to quality; while in Leith, £12 has been accepted for second-hand parcels.

Batley Water Supply.—The Executive of the Dewsbury and Heckmondwike Water Board have confirmed an agreement between the Board and the Batley Corporation for a supply of water in bulk for a period of ten years, with the proviso that the latter body may extend the term for five years, and for five more if deemed necessary. The arrangement entered into is of great importance to Batley, where a larger quantity of water is required than can be obtained from the present works. Batley will pay 6d. per 1000 gallons, and make the necessary connections with the Dewsbury and Heckmondwike mains. The maximum quantity to be supplied is 2½ m llion gallons p:r week, and the minimum 2 millions.

Conviction for Stealing Gas at Leicester.—A Leicester chemist named Alfred Hodgman, was charged last week with stealing a quantity of gas belonging to the Corporation. An inspector stated that defendant's meter was removed last June; but subsequently he saw lights burning on the premises, and discovered that a connection had been made with the service. When arrested, defendant said he was willing to pay for the gas; and at the Police Court he denied that he was guilty of stealing it. The Chairman of the Bench, however, pointed out that the offence could not have been committed by anyone who was unaware of the consequences. Defendant was fined £5, with the alternative of a month in prison.

Xmas
1906.



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from

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WARRINGTON, STRATFORD, AND LONDON.

COAL TRADE REPORTS.

Lancashire Coal Trade.

The year closes with a good deal of satisfaction all round in the Lancashire coal trade. The Coal Conciliation Board have agreed to continue for three years with a limit of wages ranging from 37½ to 60 per cent. above the standard of 1888, with an immediate advance in wages of 5 per cent. The Board are to continue to 1909, subject to three months' notice of determination of its existence, and subject to the liability to be determined at six months' notice in the event of the limitation of the hours of underground labour. The Board are to govern the wages of all underground labour and all surface labour engaged on the pit banks and screens in manipulating the coal. With regard to the coal trade itself, the demand is very firm in all sections. Prices are steady, with a bearing on the side of coalowners. The pits are in full work—so much so, that in many cases no further than Christmas Day will be allowed as a holiday this week. Next week, however, New Year's day and a day or two following will be yielded to the men. The export trade from Manchester Docks is slowly increasing. The average quotations are the same as last published.

Northern Coal Trade.

The coal trade is rather irregular; being influenced by the approach of the holidays, and the desire to get cargoes away before their effect is felt on the output. There has been a heavy production at the collieries, and the shipments of coal have been correspondingly full; while prices for any prompt quantities are very firm. In the Northumbrian steam coal trade, the price of best kinds has risen to from 12s. to 12s. 6d. per ton f.o.b.; but there is very little for sale for two or three weeks. Second-class steams are about 11s., and steam smalls from 7s. to 8s. The demand for gas coals has been extremely heavy. The shipments on the long contracts have been full, and will continue so for a few days longer. Prices of Durham gas coals range, for occasional cargoes, from about 10s. to 11s. 3d. per ton f.o.b., though higher prices are quoted occasionally. No heavy contracts are reported this week; but one of the large contracts for Denmark is now in the market for next year. Coke is firm, and gas coke is steady; while some of the inland gas-works have raised the price—as at Darlington, where broken coke is now 13s. 4d. per ton.

Scotch Coal Trade.

Trade continues to be strong and active. There is scarcely any coal in the market for delivery this year. Though the exports are down for the week, this is due to stormy weather, and not to lack of demand. The prices quoted are: Ell 10s. to 11s. 9d., splint 11s. 6d. to 11s. 9d., and steam 10s. to 10s. 3d. per ton f.o.b. Glasgow. The shipments for the week amounted to 249,221 tons—a decrease of 13,933 tons upon the preceding week, and of 9755 tons upon the corresponding week of last year. For the year to date, the total shipments have been 13,355,069 tons—an increase over 1905 of 1,393,284 tons.

Award in the Hastings Tramways Arbitration.—We learn that Mr. H. Graham Harris, M.Inst.C.E., the Arbitrator in the dispute between the Hastings and St. Leonards Gas Company and the Hastings Tramways Company (*ante*, pp. 550, 627), has made his award. It may be remembered that the Gas Company complained that some of their mains would be damaged by the working of the tramways; and they sought to have them moved at the expense of the Tramways Company. The Arbitrator has decided that the pipes in question will not be injured if they are left where they are.

Water Supply to the Southall Schools.—At the meeting of the Middlesex County Council last Thursday, a report was presented by the General Purposes Committee on the subject of a complaint by the Marylebone Guardians with respect to the quality of the water supplied to their schools at Southall by the South-West Suburban Water Company. It was stated that the County Analyst had examined the water, at the request of the Guardians, and had expressed the opinion that it was unfit for consumption; and the Committee said they had directed the attention of the Local Government Board to the matter.

Number of Public Lamps in Newcastle.—The estimates for the ensuing year which have been passed by the Newcastle City Lighting Committee provide for 180 new electric lamps, and for 420 new gas-lamps in various parts of the city. The exact number of gas-lamps which will be in operation next year will be 9794. The total cost of lighting, maintenance, and cleaning will be over £25,000; and during the season there will be, including electric-lamps at Walker, over 650 new electric-lamps in Newcastle, the total cost for these being £4600. The total amount for public lighting in Newcastle will be £26,538 3s. 11d.; and the total number of lamps, electric and gas, will be 9968.

Gas Matters at Hipperholme.—Dissatisfaction with the quality and price of the gas supplied to them, led some time ago to a deputation from the Hipperholme District Council waiting upon the Halifax Corporation Gas Committee. As a result, the Gas Committee have written informing the District Council that, after careful consideration, they cannot recommend the Halifax Town Council to make a reduction in the price of gas to consumers in the Hipperholme and Lightcliffe districts. As regards the question of a differential price for cooking, heating, and power purposes, the Committee cannot at present see their way clear to make any concession, as a similar recommendation from the Gas Committee of a reduction to consumers in the borough was rejected within the last twelve months. The Committee are, however, making such arrangements for special testing as will ensure the illuminating power of the gas being well up to the parliamentary standard. One member of the District Council remarked that the gas had been better since the deputation; while another said that if the Halifax Corporation would release them from their agreement and accept a fair valuation for the plant, he thought there were other bodies who would be prepared to supply the district with gas.

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COTTAGE LANE, CITY ROAD, LONDON.

BELL BARN ROAD, BIRMINGHAM.

Messrs. Edgar Allen and Co., Limited, of Sheffield, have secured the contract for the supply and erection of a complete coal-handling plant for the Coventry Corporation Gas-Works, to deal with 80 tons of coal per hour. It consists of one large crusher, fitted with Allen's "Imperial" manganese steel claws, and two gravity bucket conveyors, complete with 16 automatic fillers and 14 measure-valves; the chain of the conveyors being made of manganese steel, which has a breaking strain of 60 tons per square inch.

The Chairman of the Biddulph Tradesmen's Association recently opened a discussion on the price of gas supplied to them, which, at 4s. 8d. per 1000 cubic feet, he considered much too high. He suggested that an application should be made for a reduction; and a deputation was appointed to wait upon the Directors of the Gas Company and endeavour to obtain a substantial concession. Another deputation was instructed to wait upon the Biddulph Urban District Council and urge upon them the necessity of again opening up negotiations with the Gas Company for the purchase of the works.

At the annual meeting of Metropolitan Gas-Meters, Limited, held on Monday last week, Mr. L. R. de Fonblanque, who presided, stated that the business in the period covered by the report had increased between 60 and 70 per cent. The profit realized was £1500, compared with a loss of £1100 the preceding year. They had written off £500 for reconstruction expenses and £400 for depreciation of plant. The net profit was about £500, against a loss of £2000. Had it not been for the increased price of raw material, they would have been able, with the profit, to write off the whole of the debit balance. The report was adopted.

Messrs. Joseph Taylor and Co. have received a repeat order for one of their 1½-inch solid-plate lead saturators, fitted with double detachable ammonia-pipes, and one of their latest makes of ammonia waste gas and acid catch-boxes, from Messrs. W. Butler and Co., Limited, for their Bristol works; also an order for a similar plate lead catch-box for their Gloucester works. The firm have likewise received orders for a 10-ton acid tank, with cover, a portable acid tank, for carrying acid from railway to works, and one small acid tank, including pipes and connections, &c., from the Paignton Gas Company. Orders have also been received for one of their latest makes of open bell-type saturators, for a make of 4 tons of sulphate of ammonia per day, with well and steam discharger complete.

A terrible explosion occurred last Thursday afternoon at the generating works of the South Metropolitan Electric Light and Power Company, at Greenwich, resulting in the destruction of the building and machinery, and involving the loss of two lives, besides injuries to several men. The station is in proximity to the works of the South Metropolitan Gas Company, and a singularly narrow escape was experienced by a number of men working on the premises. They were standing close by the wall when the explosion occurred, and all ran from the spot as fast as they could. In a few seconds the wall was hurled down by the force of the drum of the boiler; the great mass of iron passing within a few feet of the men. In business establishments lighted by current from the works, the sudden failure of the light occasioned great inconvenience.

APPLICATIONS FOR LETTERS PATENT.

28,038.—LAKE, H. H., "Generation of gas." A communication from W. H. Cone. Dec. 8.
28,072.—WADDELL, A., "Gas fire-lighter." Dec. 10.
28,081.—QUACK, E., "Gas-stoves." Dec. 10.
28,086.—SCLATER, A. W., "Suction gas apparatus." Dec. 10.
28,094.—BIRNBACH, H., "Lighting gas at a distance." Dec. 10.
28,099.—CARR, H. O., "Temporary connections for gas-mains." Dec. 10.
28,118.—ANDERSON, D., "Self-intensifying gas-lamps." Dec. 10.
28,148.—BACHMAN, F. E., "Washing gases." Dec. 10.
28,177.—PATIENCE, S. G., "Light-diffusing crutch for incandescent gas-mantles." Dec. 11.
28,181.—CROSSLEY, W. J., and RIGBY, T., "Manufacture of producer gas." Dec. 11.
28,213.—SMITH, A. G., "Incandescent gas-lamps." Dec. 11.
28,241.—COWAN, T. W., "Gas-lamps." Dec. 11.
28,269.—WILTON, G., "Recovery of sulphur from brasses and the purification of coal gas." Dec. 11.
28,280.—WATSON, R. C., "Taps for fluids." Dec. 12.
28,387.—MANSFIELD, A., "Gasholders." Dec. 12.
28,403.—KELVEY, H. E., "Gas valves or cocks." Dec. 13.
28,495.—DEUTSCHE CONTINENTAL GAS GESELLSCHAFT and MUCKE, F., "Automatic gas-valve openers for liquid heaters." Dec. 13.
28,525.—ATKINSON, W., SMITH, J. & E., and ATKINSON, H., "Adjustably supporting gas-burners." Dec. 14.
28,526.—PARRY, H. J., and ATKINSON, H., "Coal-feeding hoppers." Dec. 14.
28,574.—THWAITE, B. H., and DEFRIES, W., "High-temperature gas-furnace." Dec. 14.
28,580.—WOODALL, H. W., and DUCKHAM, A. M'D., "Vertical retorts." Dec. 14.
28,604-5.—HOWORTH, F. W., "Buckets for steam or gas turbines." A communication from Aktiebolaget de Lavals Angturbin. Dec. 14.
28,606.—HOWORTH, F. W., "Packages for mantles." A communication from Deutsche Gasglublicht Akt.-Ges. (Auergesellschaft). Dec. 14.
28,653.—GROSSMANN, J., "Eliminating calcium sulphate from waters, trade effluents, and solutions." Dec. 15.
28,650.—KURZER, L., "Drums for gasifying heavy carburetted oils." Dec. 15.
28,665.—BIRCH, G., "Anti-vibration fittings." Dec. 15.
28,672.—STRATFORD, J., and CUTRESS, H. G., "Full-way automatic check valve secured and working in ordinary gas-barrel." Dec. 15.

A brilliant effect has just been produced outside the establishment of a large drapery company at Sandown (I. of W.) by the installation of several lamps on the Keith and Blackman high-pressure system. This is believed to be the first instance of the employment of the system in the island; and the event was celebrated by a "high-tea," at which the Chairman of the Gas Company (Mr. W. Garland) presided, and the Manager (Mr. H. W. Falkner) and staff were complimented on the promptitude with which the work had been carried out.

GAS COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 885.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
590,000	10	Oct. 12	10½	Alliance & Dublin 10 p.c.	20–21	..	5 0 0
245,112	10	,,	7½	Do. 7 p.c.	14–15	..	5 0 0
200,000	5	Nov. 14	7	Bombay, Ltd.	6½–7	..	5 0 0
40,000	5	,,	7	Do. New, £4 paid	5–5½	..	5 1 10
50,000	10	Aug. 30	14	Bourne- mouth Gas and Water } 10 p.c. B 7 p.c. Pref. 6 p.c.	28–29	..	4 16 7
51,810	10	,,	7		17–17½	..	4 0 0
53,200	10	,,	6		15–16	..	3 15 0
380,000	Stk.	Aug. 15	12½	Brentford Consolidated	260–265	..	4 14 4
300,000	,,	,,	9⅜	Do. New	200–205	..	4 12 8
50,000	,,	,,	5	Do. 5 p.c. Pref.	120–125	..	4 0 0
706,250	,,	Dec. 13	4	Do. 4 p.c. Deb.	101–104*	..	3 16 11
220,000	Stk.	Sept. 27	11½	Brighton & Hove Orig.	230–235	..	4 15 8
246,320	,,	,,	8½	Do. A. Ord. Stk.	163–168	..	4 18 3
160,000	20	Sept. 27	10	British	41–43	+½	4 13 0
104,000	Stk.	Aug 15	6	Bromley, Ord. 5 p.c.	121–125	..	4 16 0
165,700	,,	,,	4½	Do. do. 3½ p.c.	91–94	..	4 15 9
500,000	10	Oct. 12	7	Buenos Ayres (New) Ltd.	11⅜–12	..	5 16 8
250,000	Stk.	D.c. 13	4	Do. 4 p.c. Deb.	94–96*	..	4 3 4
150,000	20	July 12	8½	Cagliari, Ltd.	24–26	..	6 6 11
100,000	10	Sept. 27	0	Cape Town & Dis., Ltd.	14–15	..	6 13 4
100,000	10	Oct. 26	4½	Do. 4½ p.c Pref.	9½–10	..	4 10 0
50,000	50	Nov. 2	6	Do. 6 p.c. 1st Mort.	50–52	..	5 15 5
50,000	Stk.	June 28	4½	Do. 4½ p.c. Deb. Stk.	98–100	..	4 10 0
157,153	Stk.	Aug. 15	5	Chester 5 p.c. Ord.	108½–110½	..	4 10 6
1,443,280	Stk.	Aug 30	5⅛	Commercial 4 p.c Stk.	110–113	..	4 12 0
560,000	,,	,,	5	Do. 3½ p.c. do.	107–110	..	4 10 11
475,000	,,	Dec. 13	3	Do. 3 p.c. Deb. Stk.	83–85*	..	3 10 7
800,000	Stk.	,,	6⅓	Continental Union, Ltd.	124–127*	..	5 2 4
200,000	,,	,,	7	Do. 7 p.c. Pref.	138–143*	..	4 17 11
432,070	Stk.	Aug.	5½	Derby Con. Stk.	122–124	..	4 8 9
55,000	,,	July	4	Do. Deb. Stk.	105–107	..	3 14 9
486,090	10	July 27	11	European, Ltd.	24½–25½	..	4 6 3
354,060	10	,,	11	Do. £7 10s. paid	18–19	..	4 6 10
1,203,110	Stk.	Aug 15	4⅘	Gas- light and Coke } 4 p.c. Ord. 3½ p.c. max. 4 p.c. Con. Pref. 3 p.c. Con. Deb.	98½–99½	+½	4 8 5
2,600,000	,,	,,	3½		88–90	..	3 17 9
3,799,735	,,	,,	4		107–110	..	3 12 9
4,193,975	,,	Dec. 13	3		84–86*	..	3 9 9
258,740	Stk.	Sept. 13	5	Hastings & St. L. 3½ p.c.	98–103	..	4 17 1
8 2,500	,,	,,	6½	Do. do. 5 p.c.	118–121	..	5 7 5
70,000	10	Oct. 12	11	Hongkong & China, Ltd.	19½–20½	..	5 7 4
4,940,000	Stk.	Nov. 14	8	Imperial Continental	177–180	..	4 8 11
473,600	Stk.	Aug. 15	3½	Do. 3½ p.c. Deb. Red.	95–97	..	3 12 2
181,242	Stk.	Aug. 30	6	Lea Bridge Ord. 5 p.c.	120–125	..	4 16 0
306,083	,,	June 28	4	L'rpool Unit'd Deb. Stk.	110–112	..	3 11 5
561,000	Stk.	Aug. 30	10	Liverpool United A	229–231	..	4 6 7
718,100	,,	,,	7	Do. B	168–169	..	4 2 10
144,140	Stk.	Sept. 13	7⅝	Maidstone 5 p.c.	145–150	..	5 1 8
75,000	5	Nov. 29	5	Malta & Medn., Ltd.	4¼–4¾	..	5 5 3
560,000	100	Oct. 1	5	Met. of 5 p.c. Deb.	101–103	..	4 17 1
250,000	100	,,	4½	Melbourne 4½ p.c. Deb.	101–103	+1	4 7 5
541,920	20	Nov. 14	3⅛	Monte Video, Ltd.	11½–12⅝	..	5 12 0
1,675,892	Stk.	Aug. 15	4⅝	Newc'tle & G'tesh'd Con.	111⅜–112½	..	4 2 3
406,025	Stk.	June 29	3½	Do. 3½ p.c. Deb.	98–99	..	3 10 8
15,000	10	Aug. 30	10	North Middlesex 10 p.c.	20–21	..	4 15 3
55,940	11	,,	7	Do. 7 p.c.	13⅜–14½	..	4 16 7
300,000	Stk.	Nov. 29	8	Oriental, Ltd.	150–155	..	5 3 3
60,000	5	Sept. 13	7	Ottoman, Ltd.	5¾–6¾	..	5 12 0
398,490	5	Oct. 26	7	Primitiva Ord.	7½–8	..	4 7 6
796,980	5	July 27	5	Do. 5 p.c. Pref.	5¼–5⅝	..	4 10 11
488,900	100	Dec. 1	4	Do. 4 p.c. Deb.	94–96	..	4 3 4
851,070	10	Oct. 12	7	River Plate Ord.	12⅞–12¾	..	5 7 8
300,000	Stk.	June 28	4	Do. 4 p.c. Deb.	97–99	..	4 0 10
250,000	10	Sept. 27	8	San Paulo, Ltd.	13¼–13¾	..	5 16 5
70,000	50	July 2	5	Do. 5 p.c. Deb.	49–51	..	4 18 0
135,000	Stk.	Sept. 13	10	Sheffield A	246–248	..	4 0 8
209,984	,,	,,	10	Do. B	246–248	..	4 0 8
523,500	,,	,,	10	Do. C	246–248	..	4 0 8
70,000	10	Oct. 26	10	South African	15½–16½	..	6 1 3
6,350,000	Stk.	Aug. 15	5⅜	South Met., 4 p.c. Ord.	128–130	..	4 4 7
1,895,445	,,	July 12	3	Do. 3 p.c. Deb.	85–87	..	3 9 0
201,723	Stk	Sept. 13	8	South Shields Con. Stk.	156–158	..	5 1 3
575,000	Stk.	Aug. 15	5⅜	S'th Suburo'n Ord. 5 p.c.	123–126	..	4 7 4
60,000	,,	,,	5	Do. 5 p.c. Pref.	123–126	..	3 19 4
112,533	,,	July 12	5	Do. 5 p.c. Deb. Stk.	128–133	..	3 15 2
502,310	Stk.	Nov. 14	5	Southampton Ord.	105–110	..	4 10 11
120,000	Stk.	Aug. 30	6⅔	Tottenham A 5 p.c. and B 3½ p.c.	127–130	..	5 0 0
388,020	,,	,,	5		104–106	..	4 14 4
137,500	,,	June 28	4	Edmonton 4 p.c. Deb.	103–105	..	3 16 2
182,380	10	June 14	8	Tuscan, Ltd.	10⅝–11⅛	..	7 2 3
149,900	10	July 2	5	Do. 5 p.c. Deb. Red.	104–106	..	4 14 4
193,742	Stk.	Sept. 13	5	Tynemouth 5 p.c. max.	106–108	..	4 12 7
30,000	Stk.	Aug. 15	8	Wands- worth A 5 p.c. B 3½ p.c. C 3½ p.c.	—	..	—
255,636	,,	,,	6⅔		140–145	..	4 9 8
75,000	,,	,,	5⅝		113–115	..	4 17 6
79,416	,,	June 28	3	Putney 3 p.c. Deb. Stk.	80–83	–2	3 12 3
779,875	,,	Aug. 15	5⅜	West Ham 5 p.c. Ord.	102–104	–1	4 18 6
185,000	,,	,,	5	Do. 5 p.c. Pref.	120–123	..	4 1 4
193,300	,,	June 28	4	Do. 4 p.c. Deb. Stk.	103–106	..	3 15 6

Prices marked * are "Ex div."

WANTED, FOR SALE, CONTRACT, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Situations Vacant.

ASSISTANT ENGINEER AND MANAGER. Preston Gas Company. Applications by Jan. 8.
GENERAL OUTDOOR FOREMAN. No. 4685.
GAS FITTINGS SALESMAN. Ecliptic Gaslight Company.

Vacancy for Pupil. No. 4684.

Stocks and Shares.

CHIGWELL, LOUGHTON, &c., GAS COMPANY. Jan. 15.

TENDERS FOR

Coal and Cannel.

COPENHAGEN LIGHTING DEPARTMENT. Tenders by Jan. 3.

Gasholder (Telescoping).

TEIGNMOUTH GAS DEPARTMENT. Tenders by Jan. 8.

Oil for Gas Making.

BOGNOR GASLIGHT AND COKE COMPANY. Tenders by Dec. 31.

Tar and Liquor.

HARWICH GAS COMPANY. Tenders by Jan. 5.

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Orders for Alterations in, or stoppages of, PERMANENT ADVERTISEMENTS should be received by the FIRST POST on SATURDAY.

Wanted, For Sale, and Tender Advertisements, Six Lines and under, 3s.; each additional Line, 6d.

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GAZINE—A radical Solvent and Preventative of Naphthalene deposits, and the Automatic cleaning of Mains and Services.
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IMPORTANT NOTICE.

MR. WILLIAM EDGAR, Blenheim Works, Hammersmith, wishes to inform readers of the "JOURNAL" that, owing to pressure of business, his works will only be closed on Christmas Day and Boxing Day. Business will be resumed on Thursday morning at the works at Hammersmith and branches at Stoke Newington and Leyton. The South Shields branch will be closed from Monday the 24th inst., for one week. Work will be resumed on the 31st inst.

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For further Particulars, apply to No. 4684, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

GAS-FITTINGS SALESMAN.
SALESMAN wanted for Gas-Fittings, &c. Must be a good man.
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WANTED, by a Water Company, a competent man to Take Charge of Main and Service Layers. Must be good Cyclist. Permanent post for suitable man. Wages 38s. weekly to commence with. Two suits Uniform yearly and allowance for Bicycle.
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PRESTON GAS COMPANY.
WANTED, by the above Company an ASSISTANT ENGINEER and MANAGER Salary, £350 a Year, off which is deducted 3 per cent for Superannuation.
Applications, stating Age, Qualifications, and Experience, with Testimonials, must be received by the undersigned not later than Tuesday, the 8th of January, 1907.
HENRY GREEN,
Engineer and Secretary.

See Advertisement last week, page 880.

5538
UNIV. OF MICH.
JAN 1

THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT
[REGISTERED AS A NEWSPAPER.

VOL. XCVI. No. 2276.] LONDON, DECEMBER 25, 1906. [58TH YEAR. PRICE 6d.

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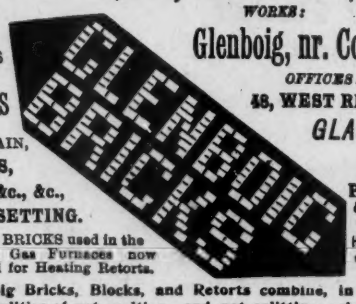

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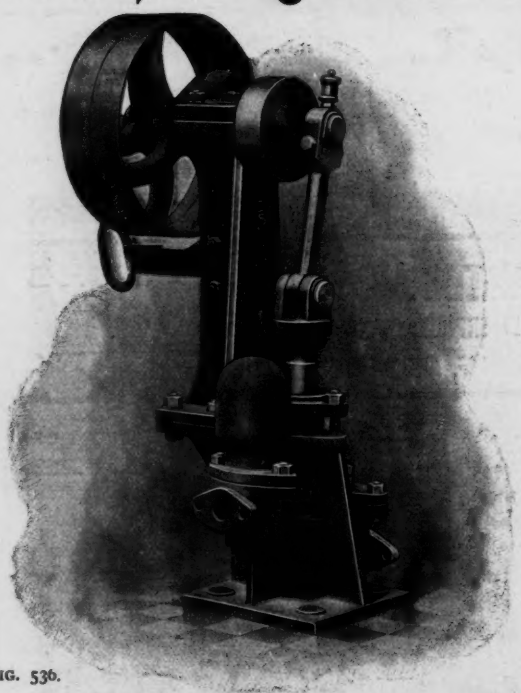

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VOL. XCVI. No. 2276.] LONDON, DECEMBER 25, 1906. [58TH YEAR. PRICE 6d.

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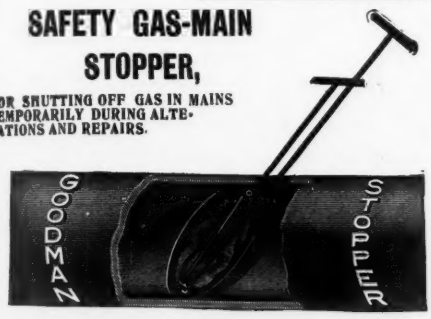

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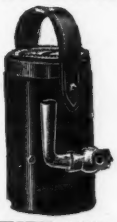

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ANALYSIS OF THE ACCOUNTS

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FOR THE YEAR 1905-1906.

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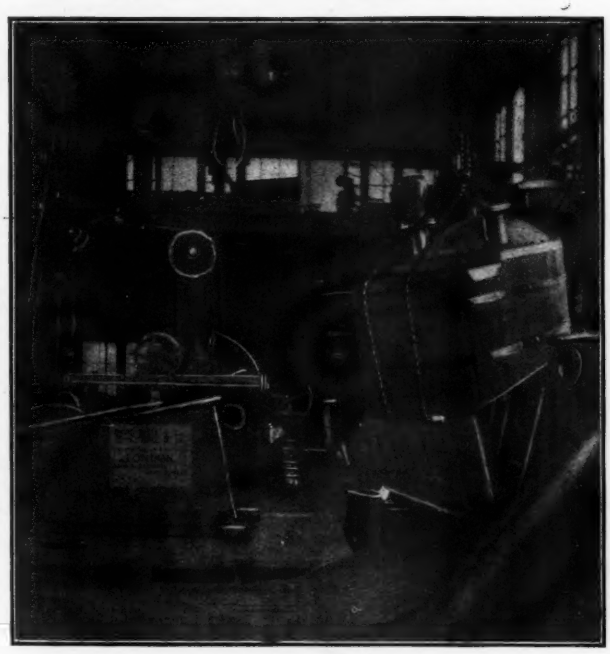
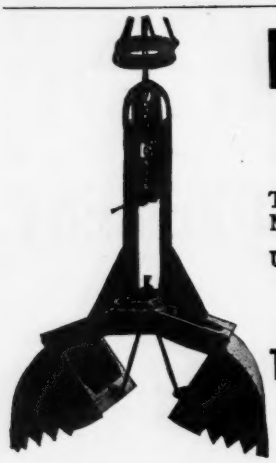


Photo. of a Corner of our Lead Burning Workshop at New Southgate.



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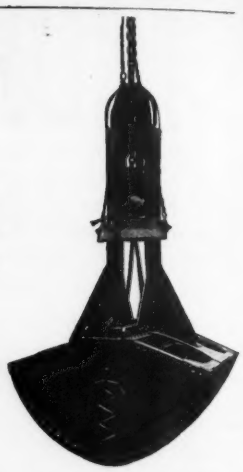

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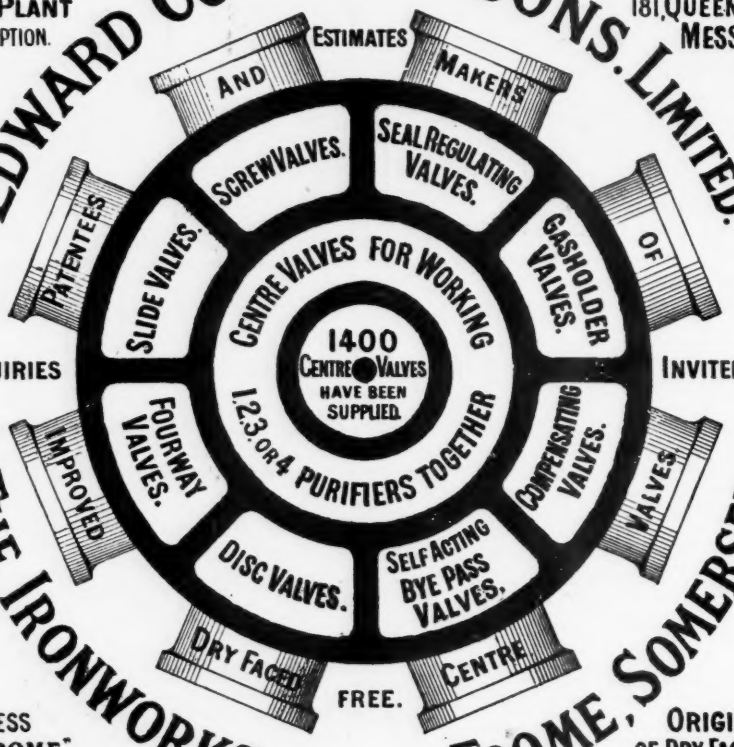

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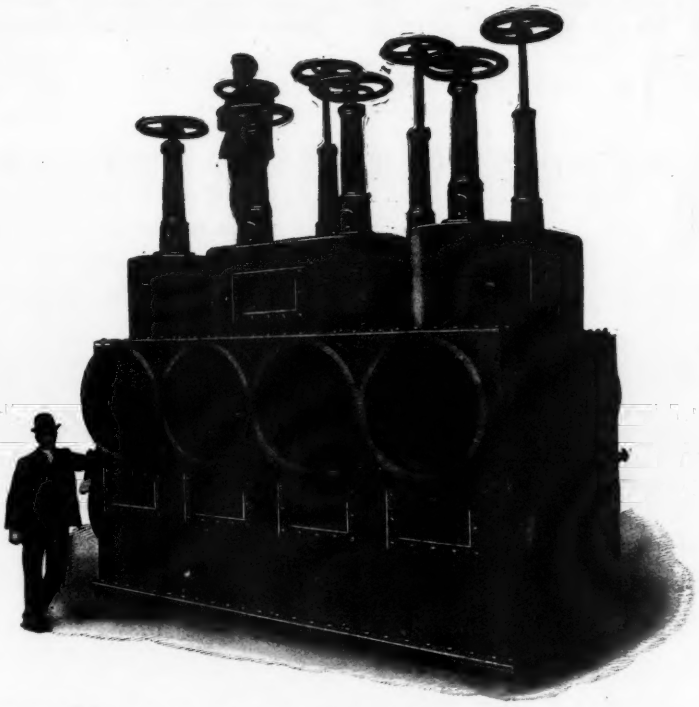

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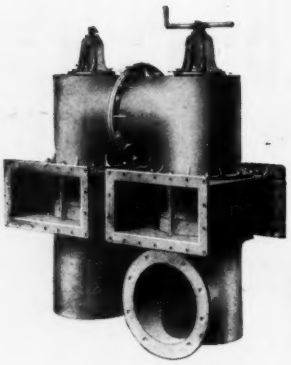

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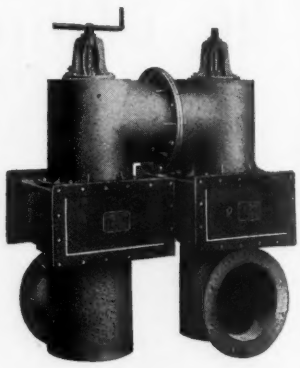

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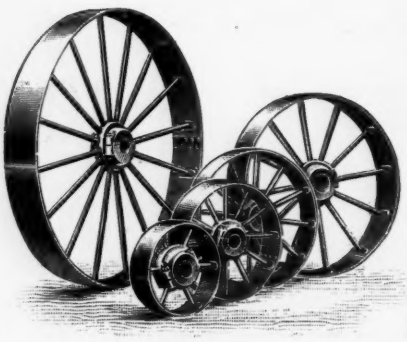

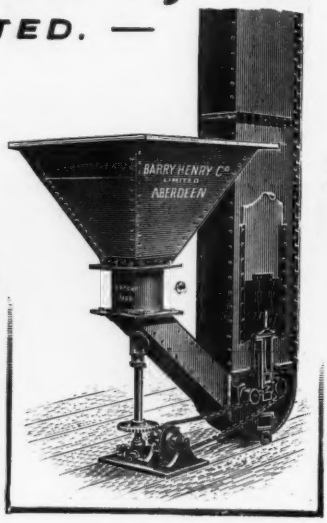

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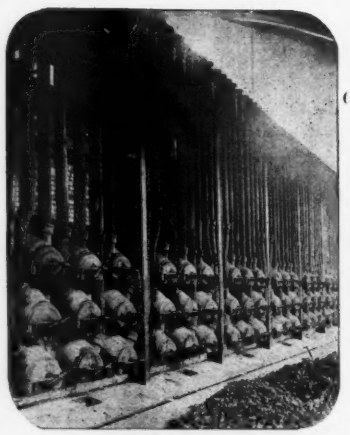

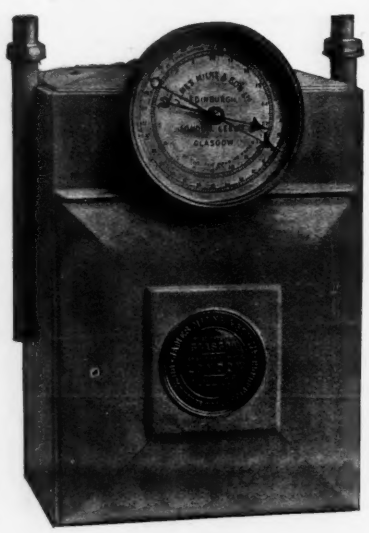

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PER HOUR FOR GAS CONSUMED.

Change Wheels

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ESTABLISHED 1860.

ARROL-FOULIS
Patent Automatic Machinery
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Full Particulars may be obtained from the Sole Makers,
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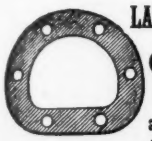

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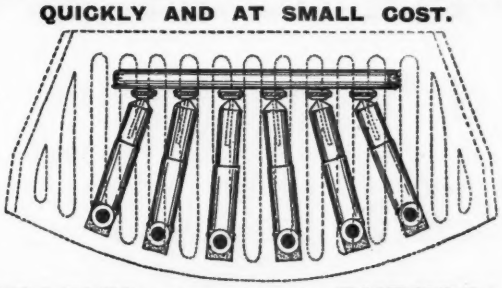

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Purifier,
30 feet × 30 feet × 6 feet,
Charged May 10,
Emptied Oct. 6.
Gas passed,
124,873,000
cubic feet =
30 °/₀ increase.
Average pressure
reduced from
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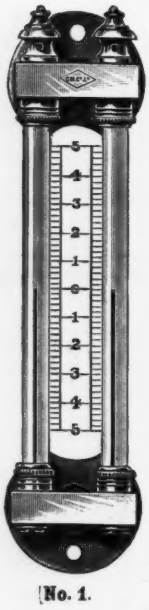

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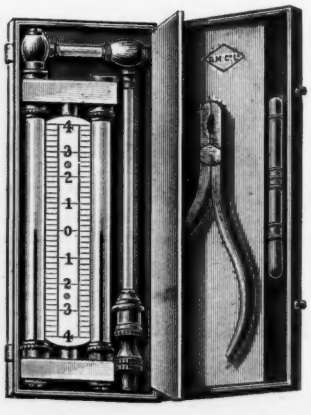

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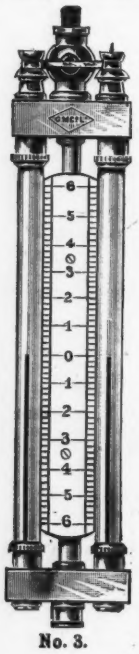

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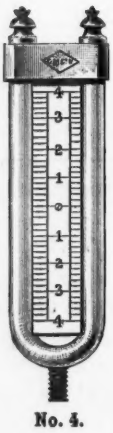

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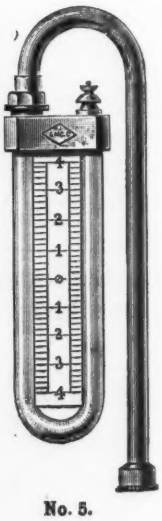

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Size of Pipe . . . . 3 inches.
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Joint failed at 850 lbs. per sq. inch.

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Depth of Lead Wool . 1½ inches.
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SILICA BRICKS for Combustion Chambers, any shape.

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Aylesbury	150,000	G. L. & C. Co., Bromley	3,750,000	Reichenberg, Bohemia	200,000
Barrow	300,000	G. L. & C. Co., Fulham	1,750,000	Romford	300,000
Bath	1,000,000	G. L. & C. Co., Nine Elms	2,750,000	Rotterdam, Holland	850,000
Belfast	1,700,000	Geneva, Switz.	500,000	Rotterdam, Holland (Second)	1,500,000
Belfast (Second)	4,500,000	Gosport	200,000	Rotterdam, Holland (Third)	750,000
Birmingham	1,500,000	Göteborg, Sweden	300,000	St. Gallen, Switz.	225,000
Bordentown, N.J.	125,000	Guildford	350,000	St. Joseph, Mo.	750,000
Bournemouth	1,000,000	Hamburg, Germany	1,750,000	Santiago de Cuba	400,000
Bremen, Germany	550,000	Hartlepool	750,000	Scarborough	800,000
Bremen, Germany (Second)	950,000	Hebden Bridge	200,000	Shanghai	225,000
Brentford	1,200,000	Heidelberg, Germany	200,000	Shanghai (Second)	225,000
Bridlington	150,000	Holyoke, Mass.	600,000	Southampton	800,000
Bridlington (Second)	200,000	Hull	1,500,000	Southampton (Second)	500,000
Brighton	1,750,000	L. & N.W. Rly., Crewe	700,000	Southgate	400,000
Brighton (Second)	1,850,000	Lawrence, Mass.	400,000	Southport	750,000
Brussels—Forest	1,000,000	Lea Bridge	350,000	Southport (Second)	900,000
Brussels—Ville	750,000	Lea Bridge (Second)	350,000	Stafford	500,000
Brussels—Ville (Second)	750,000	Liége, Belgium	1,000,000	Staines	600,000
Brussels—Ville (Third)	1,500,000	Lincoln	500,000	Stockport	600,000
Carlisle	600,000	Liverpool	3,500,000	Stockport (Second)	600,000
Chorley	300,000	Liverpool (Second)	4,500,000	Stockton-on-Tees	500,000
Commercial Gas Co.	850,000	Longton	600,000	Swansea	750,000
Commercial (Second)	850,000	Magdeburg, Germany	1,400,000	Swansea (Second)	1,000,000
Commercial (Third)	1,250,000	Maidenhead	225,000	Sydney—Harbour	500,000
Commercial (Fourth)	2,000,000	Maidenhead (Second)	225,000	Sydney—Harbour (Second)	500,000
Copenhagen	700,000	Malta	400,000	Sydney—Mortlake	500,000
Copenhagen (Second)	2,500,000	Manchester	3,500,000	Sydney—Mortlake (Second)	500,000
Coventry	600,000	Manchester (Second)	3,500,000	Syracuse, N.Y.	850,000
Coventry (Second)	600,000	McKeesport, Pa.	500,000	Taunton	225,000
Croydon	1,250,000	Merthyr Tydfil	300,000	The Hague, Holland	1,000,000
Croydon (Second)	625,000	Middlesbrough	1,250,000	Tilburg, Holland	400,000
Croydon (Third)	625,000	Newburgh, N.Y.	350,000	Tottenham	750,000
Deventer, Holland	150,000	Newburgh (Second)	250,000	Tottenham (Second)	750,000
Deventer, Holland (Second)	200,000	New York	1,200,000	Tottenham (Third)	350,000
Dorking	150,000	New York	4,000,000	Tottenham (Fourth)	1,000,000
Dublin	2,000,000	North Middlesex	150,000	Tunbridge Wells	1,000,000
Dublin (Second)	2,000,000	North Middlesex (Second)	200,000	Utrecht, Holland	1,000,000
Dunedin, N.Z.	150,000	Norwich	1,000,000	Utrecht, Holland (Second)	1,000,000
Dunedin, N.Z. (Second)	275,000	Ostend, Belgium	100,000	Waltham	400,000
Durham	200,000	Perth, W.A.	125,000	Wandsworth & Putney	1,800,000
Eastbourne	1,250,000	Port Elizabeth, S.A.	400,000	Watford	300,000
Edinburgh	2,000,000	Portsmouth	1,000,000	Watford (Second)	350,000
Epsom	225,000	Posen, Germany	450,000	West Ham	1,500,000
Falmouth	150,000	Posen, Germany (Second)	700,000	Winchester	225,000
Faversham	200,000	Preston	1,400,000	Zwolle, Holland	200,000

AND WORK UNDERTAKEN SINCE JANUARY 1, 1904.

Taunton (2nd)	350,000	Wexford, Ireland	100,000	Stockholm	1,500,000
Bognor	100,000	Budapest, Hungary	50,000	Romford (2nd)	350,000
Bournemouth (2nd)	500,000	Swindon	300,000	Cracow, Galicia	200,000
Vienna	3,500,000	Reading	1,000,000	Berlin-Rixdorf (2nd)	700,000
Maastricht, Holland	200,000	Oberhausen, Germany	175,000	Mayence	700,000
Antwerp, Belgium (2nd)	1,000,000	Malmo, Sweden	350,000	Guildford (2nd)	200,000
Tottenham (5th)	1,000,000	Ipswich	750,000	Kiel	1,000,000
The Hague, Holland (2nd)	500,000	Winchester (2nd)	125,000	Chigwell	350,000
Hampton Court	500,000	Zwolle, Holland (2nd)	200,000	Rotterdam (4th)	750,000
Lea Bridge (3rd)	400,000	Alkmaar, Holland	400,000	Haarlem, Holland	850,000
Dublin (3rd)	650,000	Leiden, Holland	500,000	Weston-super-Mare (2nd)	350,000
North Middlesex (3rd)	75,000	Poole	1,500,000	Wiesbaden	850,000
St. Gallen, Switz. (2nd)	225,000	Berlin-Rixdorf	650,000	Augsburg	425,000
Brussels—St. Josse	1,000,000	Berlin-Charlottenburg	2,500,000	Budapest (2nd)	1,750,000
Dundee	1,500,000	Bochum, Westphalia	530,000	Norwich (2nd)	300,000
Bridgwater	200,000	Brussels–Anderlecht	350,000	Bishop's Stortford	200,000
West Ham (2nd)	800,000	Leigh, Lancs.	350,000	Berlin-Tegel	3,500,000
Brieg, Silesia	100,000	Stockport (3rd)	400,000	San Paulo, Brazil	700,000
Brussels—Ville (4th)	350,000	Agram, Croatia	200,000	Reval, Russia	350,000
Innsbruck, Austria	200,000	Bruges, Belgium	200,000	Gelsenkirchen	175,000
Marlborough	100,000	Liége, Belgium (2nd)	750,000	Graudenz	200,000
Flensburg, Sleswig	300,000	Lemberg, Galicia	260,000	Schwelm	100,000
Weston-super-Mare	300,000	Leeuwarden, Holland	400,000	Hong Kong	450,000
				Kampen, Holland	350,000

HUMPHREYS & GLASGOW TOTAL . . **179,100,000** CUBIC FEET DAILY.
UNITED GAS IMPROVEMENT CO., U.S.A. **505,200,000** CUBIC FEET DAILY.
TOTAL 684,300,000 CUBIC FEET DAILY.

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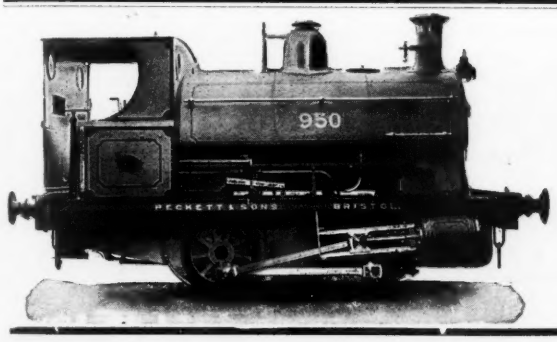

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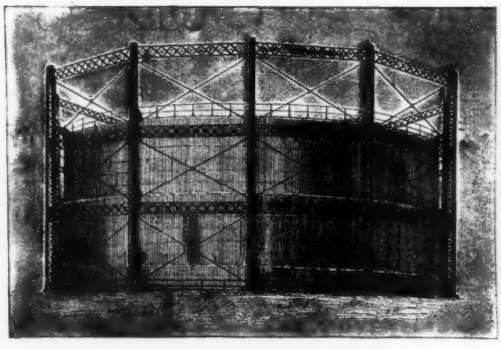

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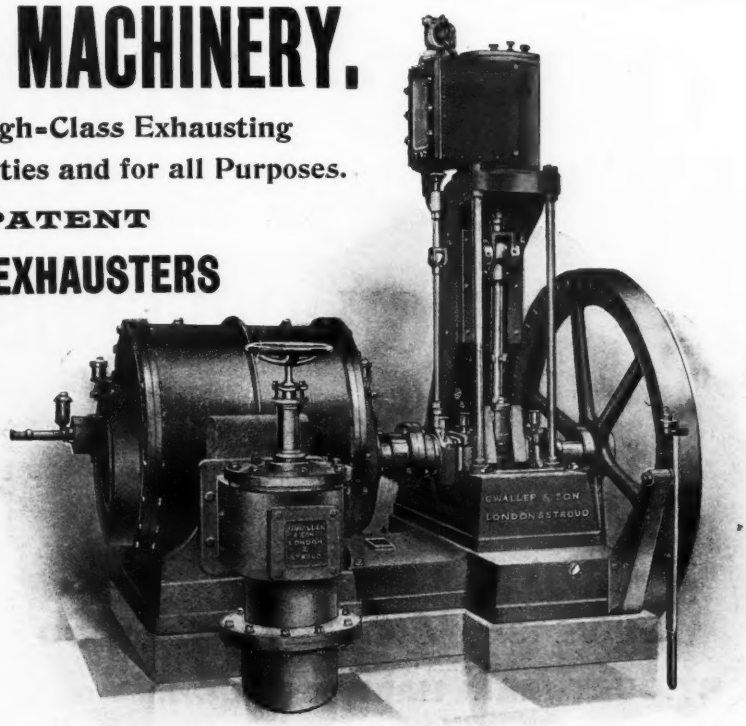

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FOR THEIR

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AT THE

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PREPAYMENT METERS.

CHANGING PRICE.
MOST SIMPLE.
NO WHEELS OR PARTS REQUIRED.

THIS METER CAN BE ALTERED *in situ.*

INSTRUCTIONS.

The Brass Plate has holes around its edge, numbered; these indicate the feet delivered for the Coin used To set the Meter, note Figs. I., II., III., IV.

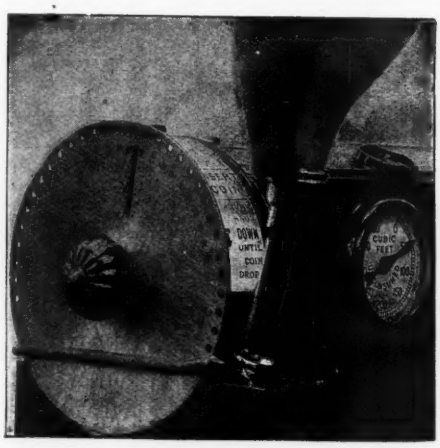

Fig. I.
Break Company's Seal and Remove Screw—THUS

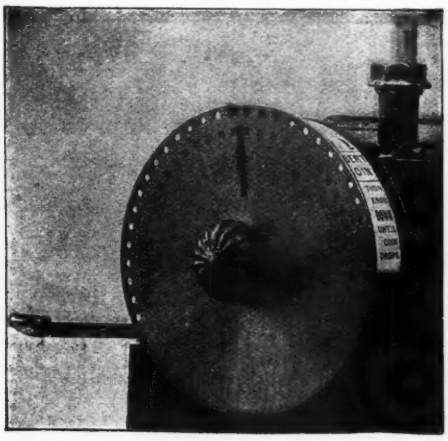

Fig. II.
Swing Band Back -THUS.

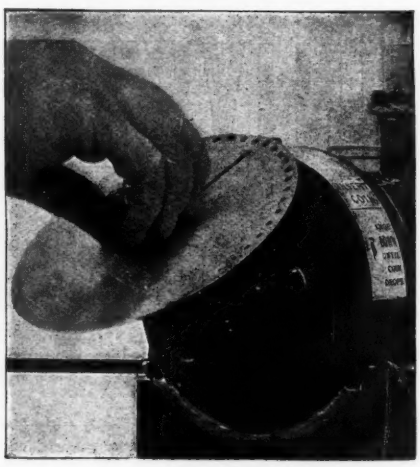

Fig. III.
Lift Plate Off—THUS.

Fig. IV.
Replace Plate—THUS.

Swing Band Forward—Replace Screw—and Re-seal.

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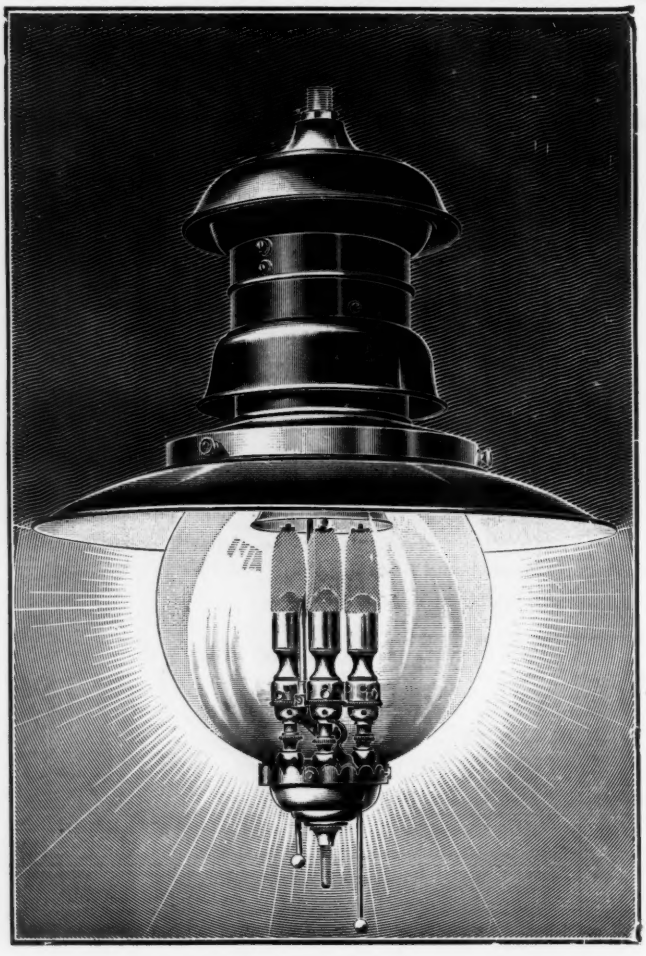

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THE Directors of the Harwich Gas and Coke Company invite TENDERS for the Surplus COAL TAR to be produced at their Works between the 1st of January and the 31st of December, 1907.
Approximate quantity, 150 Tons.
Tenders, stating price per ton in Purchaser's Tank Waggons, marked "Tender for Tar," to be delivered, on or before the 5th day of January next, to the undersigned.

GEO. BAINES,
Secretary to the
Harwich Gas and Coke Co.

BOGNOR GASLIGHT AND COKE CO., LTD.

THE Directors of the above Company are prepared to receive TENDERS for the supply of GAS OIL for One or Two Years from Jan. 1 next, at the rate of 25,000 to 30,000 Gallons per year, to be delivered at Bognor Station as required.
Tenders, endorsed "Gas Oil," to reach the undersigned by the 31st inst.
The Directors do not bind themselves to accept the lowest or any Tender.

FRANK G. WATSON,
Secretary.

Gas Offices, Bognor,
Dec. 22, 1906.

TEIGNMOUTH URBAN DISTRICT COUNCIL.
(GAS DEPARTMENT.)

THE Urban District Council of Teign- mouth invite TENDERS for TELESCOPING an 80 feet GASHOLDER.
The Drawings may be seen, and copies of the Specification obtained, on application to the undersigned, to whom a payment of One Guinea must be made. Same will be returned on receipt of a *bonâ-fide* Tender.
The Council do not bind themselves to accept the lowest or any Tender.
Sealed Tenders, endorsed "Gasholder," and addressed to A. Percival Dell, Esq., Clerk to the Council, Town Hall, Teignmouth, to be delivered not later than Ten a.m. of Tuesday, the 8th of January, 1907.

J. ALEX. GRAY,
Engineer and Manager.

Gas-Works, Teignmouth,
Dec. 14, 1906.

TENDERS FOR GAS COAL.

THE Lighting Department of Copen- hagen is prepared to receive TENDERS for the supply and delivery of 175,000 Tons of BEST GAS COAL from the beginning of March until the end of December, 1907.
The Lighting Department reserves the right to divide the Contracts between two or more Contractors.
Further Information and Conditions for the delivery may be obtained on application to Direktoren for Kôbenhavns Belysningsvæsen, Raadhuset, Copenhagen, B.
The Tenders, sealed and marked "Tilbud paa Kul," to be sent to Direktoren for Kôbenhavns, Belysningsvæsen, Raadhuset, Copenhagen, B., before the 3rd of January, 1907, Twelve o'clock, at which time the Tenders will be opened in the presence of the parties tendering who are in attendance.

THE LIGHTING DEPARTMENT OF COPENHAGEN,
Dec. 10, 1906.

ISSUES BY AUCTION OF GAS AND WATER STOCKS AND SHARES.

MR. ALFRED RICHARDS begs to notify that his ISSUES by AUCTION under PARLIAMENTARY POWERS of STOCKS and SHARES in LONDON, SUBURBAN, and PROVINCIAL GAS and WATER COMPANIES take place PERIODICALLY at the Mart, TOKENHOUSE YARD, E.C.
Terms for Issuing such Capital, and also for including in these Periodical Sales Gas and Water Stocks and Shares belonging to Private Owners, can be obtained on application at MR. ALFRED RICHARDS' OFFICES, 18, FINSBURY CIRCUS, E.C.

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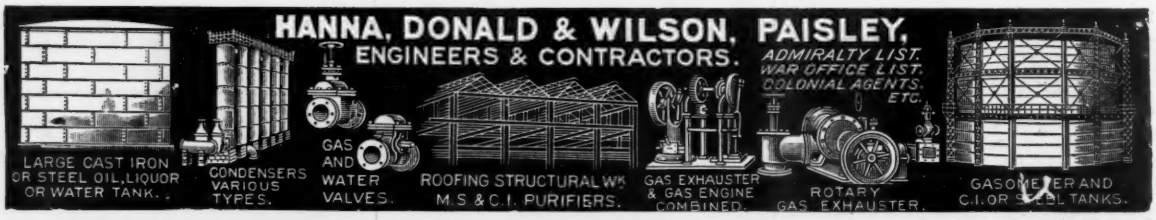
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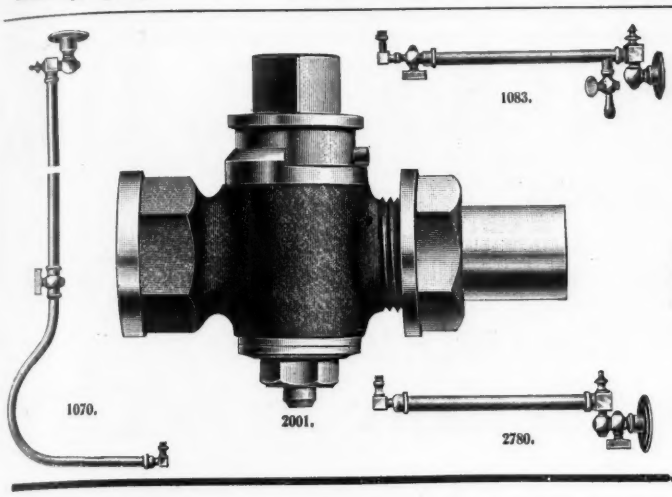

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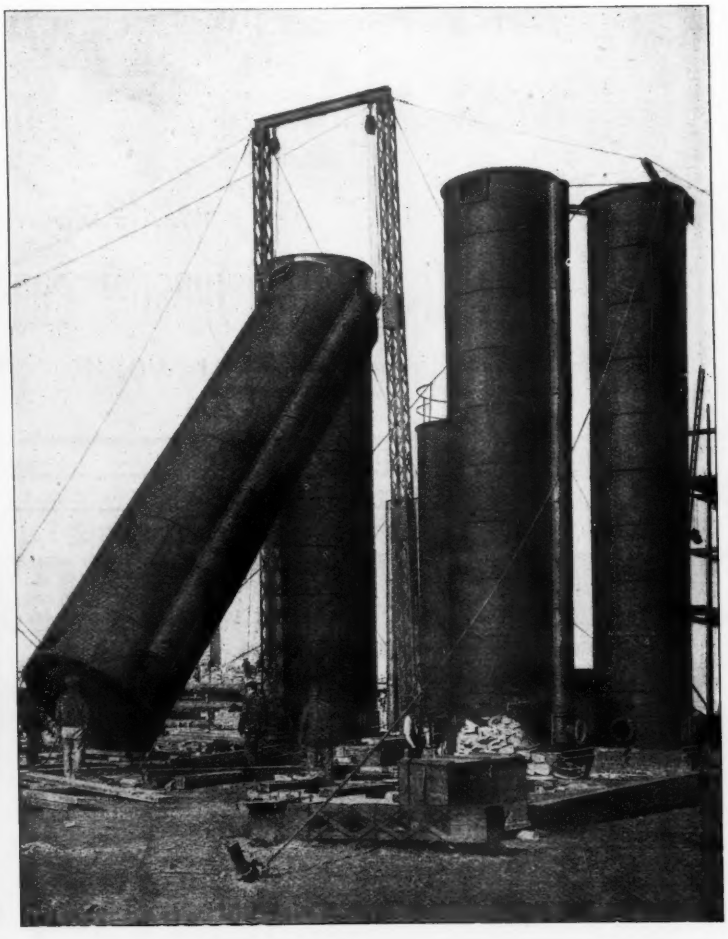

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Fig. 705. "SINGLE RAM" STEAM-PUMP.

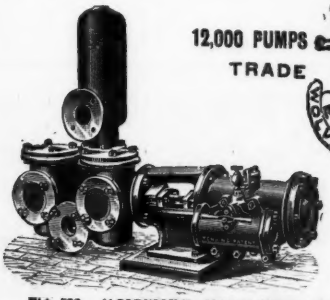

Fig. 508. "CORNISH" STEAM-PUMP FOR BOILER FEEDING, &c.

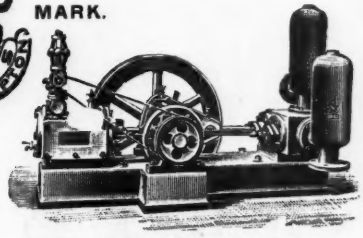

Fig. 685. "RELIABLE" STEAM-PUMP FOR TAR AND THICK FLUIDS.

Fig. 712. "DOUBLE-RAM" STEAM-PUMP.

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The GREENALL IMPROVED POSITIVE-MEASUREMENT METER.

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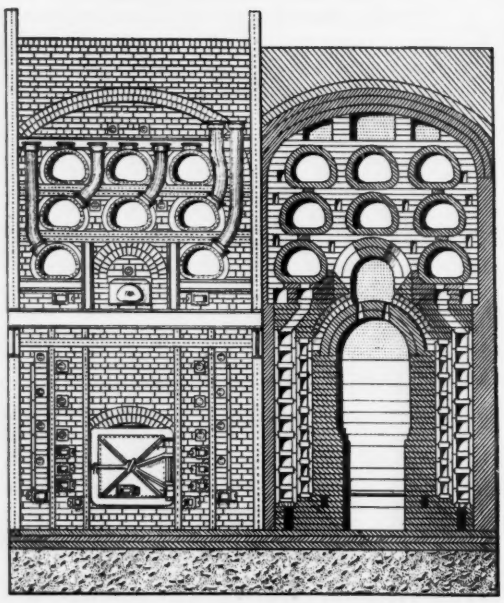

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RETORT HOUSE GOVERNORS.

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(PATENTED)

Fig. 35. 100 c.p.

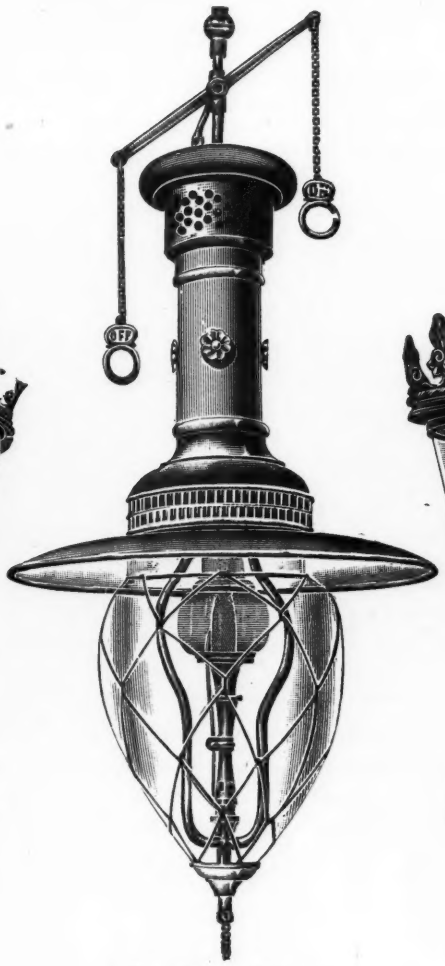

Fig. 607. 600 c.p.
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Fig. 35a. 300 c.p.
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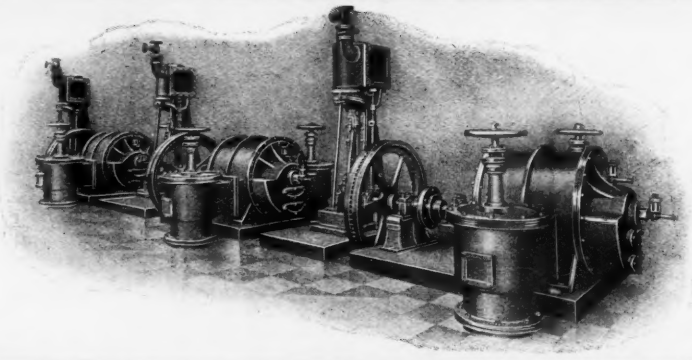

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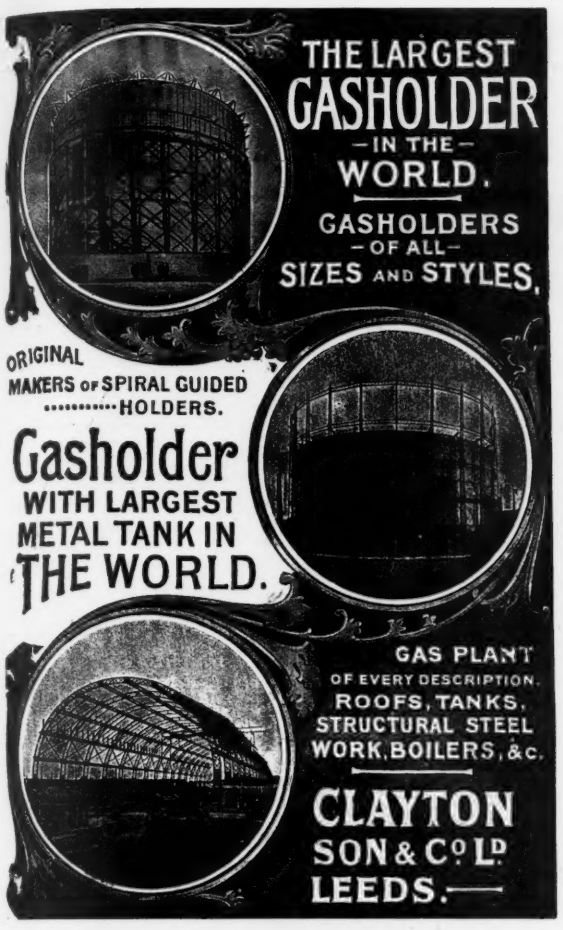

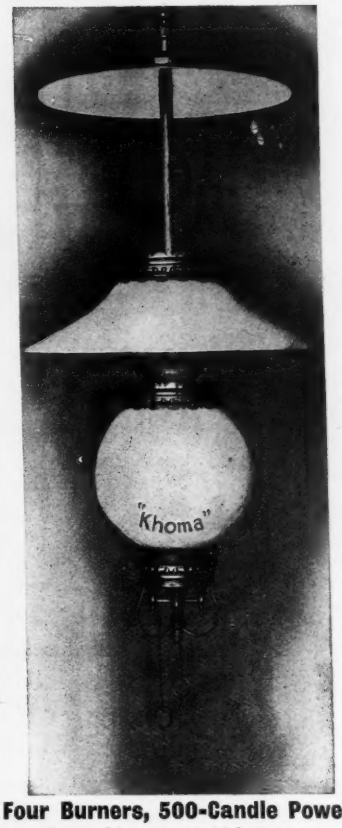

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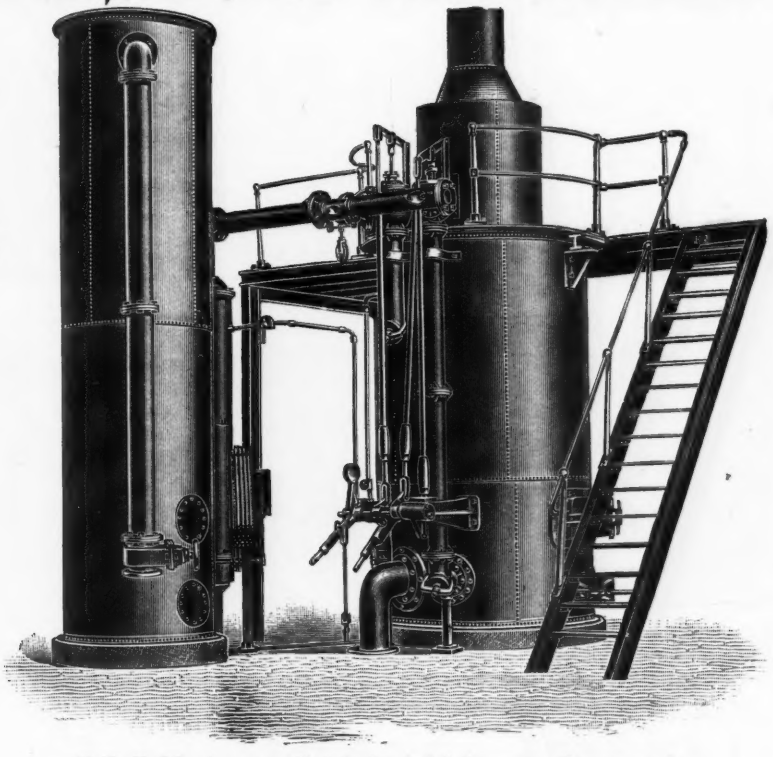

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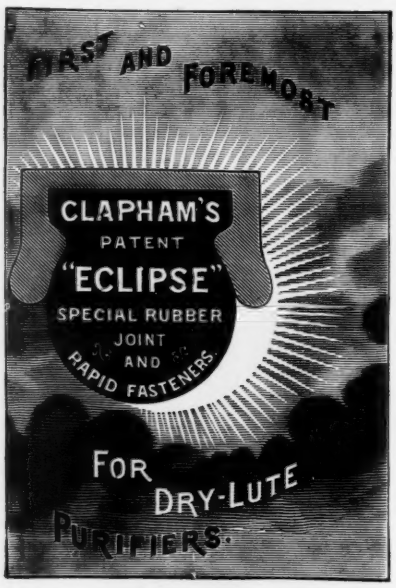

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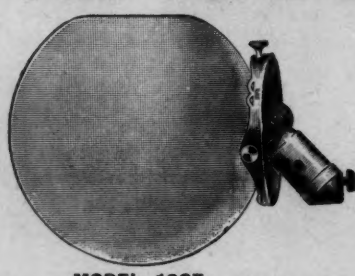

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